Vol. 9, No. 13
July 15, 1984

Energy Research Abstracts

Abstracts 24568-25180

Technical Information Center
Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $6.00, foreign $7.50 per copy; annual cumulative index, domestic $10.00, foreign $12.50 per copy. The annual subscription price is $70.00 for domestic subscribers and $87.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign).

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription as PB84-946800 from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic subscribers and $28.00 for subscribers outside the North American continent; prices for single issues are $7.00 and $14.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers. A single issue is $7.00 (domestic) and $14.00 (foreign).

***Current Energy Patents (CEP)*–PB84-902800**

Provides coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB84-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB84-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB84-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB84-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB84-901000**

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***Coal-Based Synfuels (CBS)*–PB84-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB84-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB84-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Geothermal Energy Technology (GET)*–PB84-914700**

Devoted to information on the exploration, development, and utilization of geothermal resources.

***Laser Research (LAR)*–PB84-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB84-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

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***Solar Thermal Energy Technology (STT)*–PB84-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB84-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information, Technical Information Center (TIC) cooperates with the following organizations in the publication of international abstract journals: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts;* and (3) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts.* In each case, the cognizant foreign agency provides the non-U.S. information to TIC for inclusion in the Energy Data Base; in turn, TIC provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Office of Scientific and Technical Information, Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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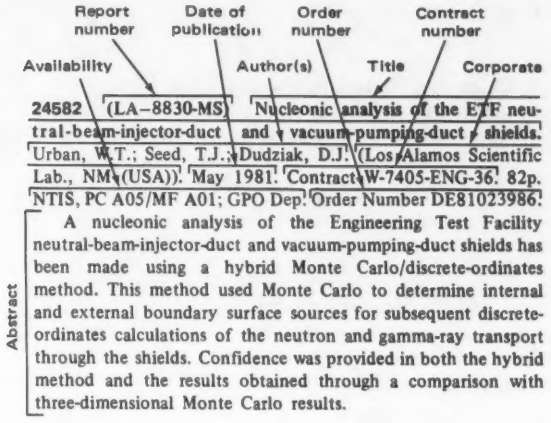
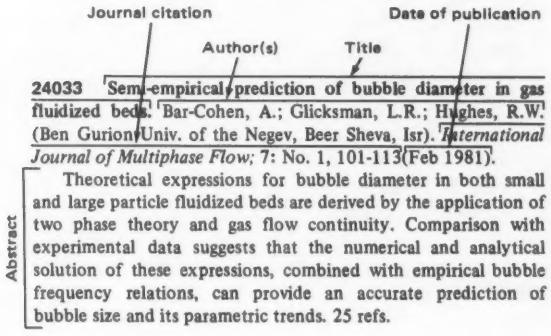
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Order number
Contract number
Availability
Author(s)
Title
Corporate
24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE81023986.
Abstract
A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.


Journal citation
Date of publication
Author(s)
Title
24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr). International Journal of Multiphase Flow; 7: No. 1, 101-113 (Feb 1981).
Abstract
Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033 (J:US)
Dudziak, D.J., *See* Urban, W.T., 6:24582
Glicksman, L.R., *See* Bar-Cohen, A., 7:24033
Hughes, R.W., *See* Bar-Cohen, A., 7:24033
Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
Neutral Atom Beam Injection
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)
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• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos National Lab., NM (USA)**	
	6:24582	LA–8830-MS

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number–Report Number Correlation is included for convenience.

LA–		
8830-MS	6:24582	NTIS, PC A05/MF A01; GPO Dep. Order Number DE81023986, Distribution Category STD-20d

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 24580, 24582, 24582, 24582, 24587, 24588, 24589, 24590, 24599, 24600, 24601

24568 (CONF-840652—3) Experimentally validated dynamic model of condensing gas-to-liquid shell and tube heat exchangers for process control design. Crapo, A.W.; Daniel, K.J. (ECP, Inc., Los Angeles, CA (USA)). 1984. Contract AC21-80ET14928. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005707.

From American Control conference; San Diego, CA, USA (6 Jun 1984).

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In order to develop advanced control systems for complex chemical processes, the engineer must be able to reliably predict the transient response of all of the components in the system. This paper reports on part of an on-going project to develop an experimentally verified engineering tool for developing controls of coal gasification fuel plants. More specifically, this paper describes the development of a model for a generic condensing, gas-to-liquid, shell and tube heat exchanger. Despite an abnormal situation, the simulation of the heat exchanger provided an accurate prediction of the exit temperatures. This shows the reliability of the model formulation. Consequently, this model could be used with confidence in the development of process control systems. 4 references, 5 figures, 1 table.

24569 (DOE/AD/11139—T1) Guidelines for developing decommissioning plans for coal conversion projects. Final report. (TRW Energy Engineering Div., McLean, VA (USA)). 22 Feb 1982. Contract AM01-81AD11139. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010861.

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This document was derived from work performed by the TRW Energy Engineering Division and its subcontractor, Burns and Roe-Humphreys and Glasgow, under Task 1 of Contract No. DE-AM01-81AD11139 for the Department of Energy's Fossil Energy, Office of Coal Processing. The objective of the document is to provide guidance and assistance to OCP personnel who are or will be involved in the planning for termination and decommissioning of coal conversion projects. It will also be useful to OCP personnel who are currently involved in the implementation of decommissioning activities as a checklist form of review; and, in addition, it will aid OC and FE top management in making decisions relative to decommissioning and in assessing the magnitude of the required effort. Although the document will not, nor is intended to make the reader an instant expert in decommissioning, its use should prevent the overlooking of critical areas of concern, aid in identifying major problem areas and/or action requirements, and provide guidance for a systematic approach to accomplishing a cost and schedule effective project/facility decommissioning effort. 6 references.

24570 (DOE/MC/14400—1551) Development of BEACON technology. Volume I. Final report, April 1980-April 1983. (TRW Energy Development Group, Redondo Beach, CA (USA)). Aug 1983. Contract FC21-80MC14400. 341p. NTIS, PC A15/MF A01; GPO Dep. Order Number DE84006316.

The BEACON process is based on the catalytic deposition of a highly reactive carbon from low heating value gases, primarily by the carbon monoxide disproportionation reaction. This carbon is subsequently reacted with steam to produce predominantly methane or hydrogen, depending on the catalyst formulation and operating conditions. Commercial application envisions an air-blown coal gasification combined-cycle power plant with a coproduct of either methane or hydrogen. Significant cost reductions are anticipated relative to corresponding oxygen-blown coal gasification systems. Excellent fluid bed catalysts have been developed which have retained initial activity for over 400 hours of steady state operation. This stability was demonstrated in a tandem reactor system which provides for semi-continuous catalyst circulation between the carbon deposition and steam gasification fluid bed reactors.

24571 (DOE/MC/19299—9) Development of a pilot-scale kinetic extruder feeder system and test program. Phase II - verification testing. Quarterly technical progress report, April-June 1983. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA). Energy Systems). 15 Jul 1983. Contract AC21-82MC19299. 38p. (LMSC/D—877750). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010825.

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The basic objective of the coal feeder program is to supply architects, process designers, and engineers with high-pressure coal feeders having predictable performance, durability, economy, and safety for all coal-conversion processes. This report covers the work carried out during the April-June 1983 quarter of the program. During the reporting period, the Model No. 6 Kinetic Extruder was assembled and the endurance test program was begun. During the month of June, about 60 h of test time was logged on the machine. The new Crane Packing Co. gas seals and the new control and instrumentation systems are performing very well. Testing is continuing. 6 figures, 5 tables.

24572 (DOE/OR/03054—60) Trace component analysis of process hydrogen streams at the Wilsonville Advanced Coal Liquefaction Facility. Bronfenbrenner, J.C. (International Coal Refining Co., Allentown, PA (USA)). Sep 1983. Contract AC05-78OR03054. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010811.

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This report summarizes subcontracted work done by the Radian Corporation to analyze trace components in process hydrogen streams at the Advanced Coal Liquefaction Facility in Wilsonville, Alabama. The data will be used to help define whether the gas streams to be treated in the hydrogen processing unit in the SRC-I Demonstration Plant will require further treatment to remove trace contaminants that could be explosive under certain conditions. 2 references.

24573 (DOE/PC/50001—22) Advanced coal liquefaction research. Quarterly technical progress report, July 1, 1983-September 30, 1983. (Gulf Research and Development Co., Shawnee Mission, KS (USA)). Apr 1984. Contract AC22-82PC50001. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010608.

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Work this quarter focused on staged liquefaction. The effect of residence time on conversion in single pass experiments was found to be quite different for the subbituminous Belle Ayr Mine and bituminous Illinois No. 6 coals studied. With bituminous coal, conversion to soluble material is quite high and the limit of conversion is approached in only a few minutes. With a subbituminous coal, however, conversion is much lower and the limit of conversion is approached much more slowly. Short contact time (SCT) dissolution of Belle Ayr coal was studied as a possible first stage in

a two-stage process. Conversion, hydrocarbon gas yield and hydrogen consumption were increased as residence time or temperature were increased. Conversion was also significantly increased by partial slurry recycle. Pyrite was found to be the most effective slurry catalyst for increasing conversion, followed by ammonium molybdate emulsion and finally nickel-molybdenum on alumina. Illinois No. 6 coal was liquefied in two stages. Conditions in the first stage dissolution were varied to determine the effect on upgradability in the second stage. An SCT (6 minute) coal dissolution stage is preferred over one at 30 minutes because hydrocarbon gas yield was much lower while overall oil yields for the combined dissolution and upgrading stages were nearly the same. Use of a $NiMo/Al_2O_3$ catalyst in a trickle-bed second stage resulted in a higher oil yield and lower product heteroatom content than use of the same catalyst in the slurry phase. The total oil yield was lower with a pyrite slurry catalyst than with a $NiMo/Al_2O_3$ slurry catalyst. With Belle Ayr coal and added pyrite, there was no change in total oil yield, conversion or product quality brought about by adding an 8-minute first stage at 450°C (842°F) to a 2-hour second stage operated at 420°C (788°F). 39 figures, 12 tables.

24574 **(DOE/PC/60787—2) Composite-bed reactor for upgrading coal-derived liquids. Quarterly report No. 2, January 1-March 31, 1984.** Crynes, B.L.; Seapan, M. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 17 Apr 1984. Contract FG22-83PC60787. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008591.

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Three experimental runs were conducted as part of the temperature zoned reactor study. The first experimental run was for familiarization and corrective purposes only. No data were taken. The two subsequent experimental runs consisted of operations at 400°C (752°F) in the bottom zone of each reactor and 400°C (752°F), respectively. The reference catalyst was Armak KF-153-S, an NiMo commercial catalyst. The reference liquid was a 15 wt % mixture SRC in a coal liquefaction process solvent. The liquid volume hourly space time across both reactor zones was 1.9 h with a 20 to 80% space time distribution between the top and bottom zones, respectively. The duration of each experiment was 72 h. Of course the reactor with the higher temperature in the top zone demonstrated increased hydrodenitrogenation. Metals from the coal liquid tended to accumulate in the middle sections of the reactors rather than at the entrance or exit. Also, within a single catalyst pellet the metals accumulated near the outer edge. The high temperature zone showed more metals deposition than found in the low temperature zone. Only partial analyses have been completed on the product liquids and catalysts. 4 tables.

24575 **(DOE/RA/50348—T5-Pt.2) High Btu gas from peat. A feasibility study. Part 2. Management plans for project continuation. Task 10. Final report.** (Minnesota Gas Co., Minneapolis (USA)). 1982. Contract FG01-80RA50348. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005567.

The primary objective of this task, which was the responsibility of the Minnesota Gas Company, was to determine the needs of the project upon completion of the feasibility study and determine how to implement them most effectively. The findings of the study do not justify the construction of an 80 billion Btu/day SNG from peat plant. At the present time Minnegasco will concentrate on other issues of peat development. Other processes, other products, different scales of operation - these are the issues that Minnegasco will continue to study. 3 references.

24576 **(DOE/RA/50348—T10) High-Btu gas from peat. A feasibility study. Task 11. Technical support. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). May 1982. Contract FG01-80RA50348. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84005563.

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In September 1980, the US Department of Energy awarded grant No. DE-FG01-80RA50348 to the Minnesota Gas Company (Minnegasco) to evaluate the commercial viability - technical, economic and environmental - of producing 80 million SCF/day of substitute natural gas (SNG) from peat. Minnegasco's project team for this study consisted of Dravo Engineers and Constructors (for design, engineering and economics of peat harvesting, dewatering and gasification systems); Ertec, Inc. (for environmental and socioeconomic analyses); Institute of Gas Technology (for gasification process information, and technical and engineering support). This report presents the work conducted under Task II (Technical Support) by the Institute of Gas Technology (IGT), the developer of the PEATGAS process, which was selected for the study. Task achievements are presented for: gasifier design and performance; technical support; and task management. 12 figures, 22 tables.

24577 **(DOE/RA/50348—T11) High-Btu gas from peat. A feasibility study. Task 9.2. Financial risk analysis. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). May 1982. Contract FG01-80RA50348. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84005564.

In September 1980, the US Department of Energy awarded grant No. DE-FG01-80RA50348 to the Minnesota Gas Company (Minnegasco) to evaluate the commercial viability - technical, economic, and environmental - of producing 80 million SCF/day of substitute natural gas (SNG) from peat. Minnegasco's project team for this study consisted of Dravo Engineers and Constructors (for design, engineering and economics of peat harvesting, dewatering and gasification systems); Ertec, Inc. (for environmental and socioeconomic analyses); Institute of Gas Technology (for gasification process information, and technical and engineering support) and Deloitte Haskins & Sells (for management structural support.) This final report presents the work conducted under Task 9.2 (Risk Assessment) by the Institute of Gas Technology (IGT), the developer of the PEATGAS process selected for the study. At this time, there is little technical doubt that the PEATGAS gasifier can indeed operate. In order to assess the risks associated with the peat gasification facility, it was subdivided according to the following risk areas; (1) peat harvesting; (2) peat dewatering; (3) peat gasification; and (4) environmental. In summary, the risks associated with the peat gasification facility are manageable. Even under the extreme risk of no peat availability, the gasification facility can be operated with lignite at a slightly higher SNG price. 1 figure, 5 tables.

24578 **(DOE/RA/50348—T5-Pt.1-Exec.Summ.) High btu gas from peat. A feasibility study. Part 1. Executive summary. Final report.** (Minnesota Gas Co., Minneapolis (USA)). 1984. Contract FG01-80RA50348. 45p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84005566.

In September, 1980, the US Department of Energy (DOE) awarded a Grant (No. DE-FG01-80RA50348) to the Minnesota Gas Company (Minnegasco) to evaluate the commercial viability - technical, economic and environmental - of producing 80 million standard cubic feet per day (SCFD) of substitute natural gas (SNG) from peat. The proposed product, high Btu SNG would be a suitable substitute for natural gas which is widely used throughout the Upper Midwest by residential, commercial and industrial sectors. The study team consisted of Dravo Engineers and Constructors, Ertec Atlantic, Inc., The Institute of Gas Technology, Deloitte, Haskins & Sells and Minnegasco. Preliminary engineering and operating and financial plans for the harvesting, dewatering and gasification operations were developed. A site in Koochiching County near Margie was chosen for detailed design purposes only; it was not selected as a site for development. Environmental data and socioeconomic data were gathered and reconciled. Potential economic data were gathered and reconciled. Potential impacts - both positive and negative - were identified and assessed. The peat resource itself was evaluated both qualitatively and quantitatively. Markets for plant by-products were also assessed. In summary, the technical, economic, and environmental assessment indicates that a facility producing 80 billion Btu's per day SNG from peat is not commercially viable at this time. Minnegasco will continue its efforts into the development of peat and continue to examine other options.

24579 **GASIFY 5.1 - a pilot plant simulator for the BI-GAS process.** Andria, G.D.; Uram, M.J. (Bituminous Coal Research, Inc., Monroeville, PA). pp 211-216 of Modeling and simulation. Vol. 12, Part 1. Energy and the environment. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1981). (CONF-810477—Vol.1). Contract AC01-76ET10312.

From 12. modeling and simulation conference; Pittsburgh, PA, USA (30 Apr 1981).

Over the years, a variety of thermodynamic, kinetic, and fluid-dynamic models have been utilized in developing coal conversion technologies. Recently, a versatile, thermodynamically controlled simulator (GASIFY 5) has been constructed to aid and evaluate BI-GAS pilot-plant operations. As designed, GASIFY 5 runs interactively on a PDP 11/34 minicomputer while providing broad computational flexibility and efficiency. The structure, relevance, and effectiveness of the simulator is discussed in terms of its appropriateness to process studies.

0105 By-products

24580 (DOE/RA/50348—T5-Pt.3) High Btu gas from peat. A feasibility study. Part 3. Market analysis. Task 8. Final report. (Minnesota Gas Co., Minneapolis (USA)). 1982. Contract FG01-80RA50348. 37p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84005565.

The primary objective of this task, which was the responsibility of the Minnesota Gas Company, was to identify and characterize the market potential for the plant by-products - BTX (mixture of benzene, toluene and xylene), phenol, ammonia, sulfur, and sodium sulfate - and to assign value to them. Although traditionally a growth industry, the chemicals market has been generally weakened by the recession, and is experiencing back to back years of declining production. This is due to bad health of specific end uses, such as fertilizer from ammonia. In the long run, this trend is expected to moderate. It is felt that the proposed peat plant has a favorable position in the markets of each of its by-products. This is due to the synergism with nearby industries which are major consumers of these by-products. In the case of sulfur and ammonia, the Red River agricultural area is a large potential market. For sodium sulfate, phenols and perhaps BTX, the nearby paper and timber products industries are large potential markets. The values for these by-products used in the financial analysis were intentionally conservative. This is because of the uncertainty in the quantity and quality. More tests are needed in an integrated facility in order to determine these factors and the variability of each. This is particularly true of the by-product oils which could vary significantly with operating conditions and may even require alternate processing schemes. 18 references, 9 figures, 14 tables.

0106 Properties

REFER ALSO TO CITATION(S) 24574, 24591, 24592

24581 (DOE/ET/13800—7) Radionuclides in US coals. Bisselle, C.A.; Brown, R.D. (Mitre Corp., McLean, VA (USA). METREK Div.). Mar 1984. Contract AC01-80ET13800. 88p. (MTR—83-W-234). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84008562.

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The current state of knowledge with respect to radionuclide concentrations in US coals is discussed. Emphasis is placed on the levels of uranium in coal (and lignite) which are considered to represent a concern resulting from coal combustion; areas of the US where such levels have been found; and possible origins of high radionuclide levels in coal. The report reviews relevant studies and presents new data derived from a computerized search of radionuclide content in about 4000 coal samples collected throughout the coterminous US. 103 references, 5 figures, 5 tables.

24582 (DOE/FE/60181—17) Low-rank coal research under the UND/DOE cooperative agreement. Quarterly technical progress report, April 1983-June 1983. Wiltsee, G.A. Jr. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1983. Contract FC21-83FE60181. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84008488.

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Progress reports are presented for the following tasks: (1) gasification wastewater treatment and reuse; (2) fine coal cleaning; (3) coal-water slurry preparation; (4) low-rank coal liquefaction; (5) combined flue gas cleanup/simultaneous SO/sub x/-NO/sub x/ control; (6) particulate control and hydrocarbons and trace element emissions from low-rank coals; (7) waste characterization; (8) combustion research and ash fowling; (9) fluidized-bed combustion of low-rank coals; (10) ash and slag characterization; (11) organic structure of coal; (12) distribution of inorganics in low-rank coals; (13) physical properties and moisture of low-rank coals; (14) supercritical solvent extraction; and (15) pyrolysis and devolatilization.

24583 (DOE/FE/60181—68) Mineral transformations during ashing and slagging of selected low-rank coals. Falcone, S.K.; Schobert, H.H.; Rindt, D.K.; Braun, S. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1984. Contract FC21-83FE60181. 11p. (CONF-840614—45). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009230.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The purpose of this study is to identify mineral transformations in low to high temperature ashes (125°, 750°, and 1000°C) and slags (1300°C) characteristic of lignites. The processes responsible for certain mineral transformation are also examined. Twelve low-rank coals were selected from the northern Great Plains and Gulf Coast. Nine North Dakota lignites, two Gulf Coast (Texas and Alabama) lignites, and one subbituminous coal from Montana were studied. The results of this study reflect the preliminary stage of investigation into the mineral phase transformations seen in low-rank coals. The original mineralogies of coals sampled do not vary a great deal. Quartz, kaolinite, pyrite, and bassanite are found in abundance in each LTA sample. Greater differences between samples are apparent at higher temperatures where complex aluminosilicates predominate. Perhaps this is a reflection of diffrences not so much in original mineral matter but in the total inorganic composition of the coal, specifically the presence of exchangeable alkali cations. The interactions of such organically-bound cations with crystalline inorganic phases in lignites account for differences in ashing and slagging behavior between coal samples. The processes responsible for most reactions identified are oxidation, dehydration, sulfur fixation, solid-state interactions, vaporization, and recrystallization. Isolating specific reactions occurring in a multi-component system is difficult at best. Understanding the thermodynamics of mineral transformations is a necessity and will be pursued in future study. In addition, future studies isolating mineral pairs to observe phase transformations at various temperatures will support or refute results presented here. 13 references, 2 tables.

24584 Mass spectrometric study of the release of HCl and other volatiles from coals during mild heat treatment. Herod, A.A.; Hodges, N.J.; Pritchard, E.; Smith, C.A. (National Coal Board, Coal Research Establishment, Stoke Orchard, Cheltenham, Glos.). *Fuel;* **62**: No. 11, 1331-1336(Nov 1983). Contract AC22-79ET13397.

The evolution of HCl and other volatiles during the mild heat treatment of six UK coals in helium was followed by mass spectrometry (m.s.). The coals, which contained $\approx$ 0.4-0.9%wt/wt chlorine, were heated at 2°C min-1 to 300°C before being heated isothermally for $\approx$ 24 h. Between 40 and 60% of the chlorine was emitted as HCl; no other chlorine-containing volatiles were identified. The HCl losses did not correlate with the initial chlorine contents of the coals. Volatiles other than HCl included carbon dioxide, sulphur dioxide, water, alkanes, alkyl benzenes, alkyl naphthalenes, alkyl phenanthrenes, and the oxygenates, phenols and dibenzofurans. The volatiles appeared to have evaporated from the micropores of the coal rather than having been formed by thermal decomposition. First-order release of HCl from five of the coals suggested that the rate-controlling step may be either diffusion through micropores or breakdown of an ionic complex within the pores. The emission of HCl did not correlate with that of any of the volatile organic compounds and the temperature of appearance of HCl showed no simple pattern. A low-temperature maximum in HCl emission was found for three coals and, in two cases, was associated with steam evolution.

24585 **Concentration of sulphur and mineral rich components in particle classes during coal comminution.** Lytle, J.M.; Daniel, J.L.; Tingey, G.L. (Pacific Northwest Laboratory, Richland, WA). *Fuel;* 62: No. 11, 1299-1303(Nov 1983). Contract AC06-76RL01830.

Particle-by-particle compositional analyses, using scanning electron microscopy and quantitative X-ray fluorescence, of lignite comminuted at 20°C in helium showed that during milling a more porous component was ground more rapidly than a less porous component, so that a bimodal distribution of coal mass versus particle size was observed. The finer material that initially was the more porous component had significantly less organic sulphur and aluminium and more inorganic sulphur than the courser, less porous component after seven hours of comminution. Other elements such as Si, Ca and Ti, and possibly Mn and Zn, also concentrated in the fines after seven hours of comminution but were not concentrated in the more porous component initially.

0108 Waste Management

REFER ALSO TO CITATION(S) 24582

24586 **(DOE/FC/10225—1584) On-site field tests for study of low-rank western coal fly ash. Technical summary report, field test No. 3. Big Brown Station electrostatic precipitator.** Dahlin, R.S.; Bickelhaupt, R.E.; Marchant, G.H. Jr.; Gooch, J.P. (Southern Research Inst., Birmingham, AL (USA)). Feb 1984. Contract AC18-80FC10225. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010496.

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This report describes the results of field and laboratory studies of combined NH_3 and SO_3 conditioning at the Big Brown Station of Texas Utilities Generating Company. This unusual combination of conditioning agents is used routinely at the Big Brown Station in order to improve the performance of the cold-side electrostatic precipitators. The primary objectives of this field study were to evaluate the performance of one of the Big Brown precipitators, and to obtain data on the concentration, composition, and size distribution of the fly ash, as well as the composition of the flue gas and the overall and fractional collection efficiencies of the precipitator. The laboratory studies of the Big Brown fly ash were intended to further characterize the ash both physically and chemically, and to study the attenuation of the electrical resistivity of the ash associated with the surface film produced by the dual conditioning process and by the use of SO_3 conditioning alone. 6 references, 22 figures, 9 tables.

24587 **(DOE/OR/03054—10) Wastewater characterization and treatability studies. Final technical report.** (International Coal Refining Co., Allentown, PA (USA)). Jan 1983. Contract AC05-78OR03054. 394p. NTIS, PC A17; 3; GPO Dep. Order Number DE84010810.

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An experimental program was conducted to evaluate the wastewater treatment system designed for International Coal Refinery Company's proposed Solvent-Refined Coal Demonstration Plant. The system consists of primary, secondary, and tertiary treatment steps. Because actual waste-water was unavailable, samples from operating pilot units were characterized and a reasonable surrogate was selected. The primary pretreatment step, to remove gases, oil, and grease, was tested on the surrogate wastewater. H_2S and NH_3 were removed by degassing, and tar acids were precipitated by lowering the pH. The pretreated water was then fed to two parallel secondary biotreatment systems, which remove phenolics and nitrify reduced nitrogens. One system contained only biomass; the other also contained powdered activated carbon (PAC). The system with PAC performed better. Effluents from the system without PAC were used for tertiary screening tests, designed to treat the water so that it would be acceptable for surface water discharge or for a closed-loop (zero-discharge) system that includes a reverse osmosis step. The results show that the wastewater purified by this treatment system is of high quality and appears to be suitable for discharge. However, to determine whether the treated water is also suitable for closed-loop (zero-discharge) operation (particularly its potential for reverse osmosis membrane fouling) requires more work. Additional tests have been planned. 31 references, 53 figures, 78 tables.

24588 **(ORNL/TM—9031) Fixed-film, fluidized-bed bioreactors for biooxidation of coal conversion wastewaters. Progress report, October 1, 1982-September 30, 1983.** Donaldson, T.L.; Strandberg, G.W.; Hewitt, J.D.; Shields, G.S. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010641.

Fixed-film, fluidized-bed bioreactors have been used successfully to treat dilute synthetic wastewaters on a continuous basis for more than 1 year and dilute actual coal conversion wastewaters for 3 months. The bioreactors have exhibited stable biological activity, and no difficult operating problems have been encountered. Effluent phenol concentrations of $\leq$ 1 mg/L have been obtained using synthetic wastewater containing 30 to 40 mg/L of phenol. Volumetric reaction rates in the bioreactors are substantially higher than those in suspended growth systems (such as activated sludge) because of the high concentration of retained cells on the support particles. Bioreactor performance, batch kinetic studies, and development, characterization, and preservation of the microbial culture are described.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 24578, 24797

24589 **(DOE/RA/50348—T8-Vol.3-Pt.A) High Btu gas from peat. Volume III. Part A. Environmental and socioeconomic feasibility assessment.** (Ertec Atlantic, Inc., Somerset, NJ (USA)). Jun 1982. Contract FG01-80RA50348. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84005560.

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In September 1980, the US Department of Energy awarded a grant (No. DE-FG01-80RA50348) to the Minnesota Gas Company (Minnegasco) to evaluate the current commercial viability - technical, economic, environmental, financial, and regulatory - of producing 80 million SCF/day of substitute natural gas (SNG). Minnegasco's project team for this study consisted of Dravo Engineers & Constructors (for design, engineering, and economics of peat harvesting, dewatering, and gasification systems), Ertec, Inc. (for environmental and socio-economic analyses), IGT (for providing gasification process information, and technical and engineering support to Minnegasco) and Deloitte Haskins and Sells (for providing management structural support to Minnegasco). This Final Report presents the work conducted by Ertec, Inc. under tasks 6 and 7. The study objective was to provide an initial environmental and socio-economic evaluation of the proposed facility to assess project feasbility. To accomplish this objective, detailed field studies were conducted in the areas of Hydrology, Air Quality and Socio-Economics. Less extensive surveys were conducted in the areas of Geology, Ecology, Acoustics, Land Use, Archaeology and Resource Assessment. Part A of Volume 3 contains the introduction and plant area conditions which include the following: (1) description of existing conditions-geology; (2) hydrology; (3) terrestrial and aquatic ecology; (4) meteorology; (5) land use existing conditions; (6) archaeology; (7) aesthetics-existing conditions; (8) acoustics; (9) existing socioeconomic conditions; and (10) resource assessment. 25 figures, 55 tables.

24590 **(DOE/RA/50348—T8-Vol.3-Pt.B) High Btu gas from peat. Volume III. Part B. Environmental and socioeconomic feasibility assessment.** (Ertec Atlantic, Inc., Somerset, NJ (USA)). Jun 1982. Contract FG01-80RA50348. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84005559.

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In September 1980, the US Department of Energy awarded a grant (No. DE-FG01-80RA50348) to the Minnesota Gas Company (Minnegasco) to evaluate the current commercial viability - technical, economic, environmental, financial, and regulatory - of

producing 80 million SCF/day of substitute natural gas (SNG). Minnegasco's project team for this study consisted of Dravo Engineers & Constructors (for design, engineering, and economics of peat harvesting, dewatering, and gasification systems), Ertec, Inc. (for environmental and socio-economic analyses), IGT (for providing gasification process information, and technical and engineering support to Minnegasco), and Deloitte Haskins and Sells (for providing management structural support to Minnegasco). This Final Report presents the work conducted by Ertec, Inc. under tasks 6 and 7. The study objective was to provide an initial environmental and socio-economic evaluation of the proposed facility to assess project feasibility. To accomplish this objective, detailed field studies were conducted in the areas of Hydrology, Air Quality and Socio-Economics. Less extensive surveys were conducted in the areas of Geology, Ecology, Acoustics, Land Use, Archaeology and Resource Assessment. Part B of Volume 3 contains the following contents: (1) project impact assessment which covers geological impacts, hydrology, ecological impacts, air quality and meteorology, land use, archaeology, aesthetics, acoustics, socioeconomic impacts, and peat resources; (2) impact mitigation which covers hydrology, ecology, air quality, archaeology, acoustics, and socioeconomics; (3) conclusions; and (4) appendices. 2 figures, 18 tables.

0120 Mining

REFER ALSO TO CITATION(S) 24599, 24601

0130 Transport And Handling

REFER ALSO TO CITATION(S) 24582, 24585

24591 **(DOE/EV/04427—62-App.E) Evaluation of the effect of coal cleaning on fugitive elements. Appendix E. Final report, Phase III.** Ford, C.T.; Price, A.A. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Jul 1982. Contract AC22-77EV04427. 350p. (COO—4427-62-App.E). NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84010955.

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Appendix E contains the washability curves which were generated to determine if washability data predict the removal of trace and major elements as effectively as they predict ash and sulfur removal. These data include specific gravity (yield) curves and cumulative float constituent curves from washability studies on two size fractions of six coals for ash, total sulfur and pyritic sulfur, as well as for sixteen trace elements and nine major elements in coal. A brief discussion of the procedure used is given in this Appendix. A more detailed description can be found in the main report. 2 references, 2 figures, 2 tables.

24592 **Effect of microstructure on the size and shape of coal particles during comminution.** Lytle, J.M.; Daniel, J.L.; Prisbery, K.A. (Battelle, Pacific Northwest Laboratory, Richland, WA). *Fuel;* 62: No. 11, 1304-1309(Nov 1983). Contract AC06-76RL01830.

Coal samples were comminuted in a ball mill under controlled temperature (20°C), in helium. Microstructural analyses of the coal particles before ball milling and at various times during milling showed relationships between the microstructure and the size and shapes of the resulting particles. During milling, fracture lines tended to proceed through pores and cracks and organic-to-organic and mineral-to-organic interfaces, and thus these features greatly influenced the size and shapes of particles produced. In the early stages of milling, a porous component of lignite produced needle-like or plateshaped particles that were later broken into blocky and rounded particles. Another less porous component of lignite produced blocky and rounded particles during all stages of milling.

24593 **Enlightened coal slurries.** Faddick, R.R. (Colorado School of Mines). pp 165-174 of Proceedings of Eighth International Technical Conference on Slurry Transportation. Washington, DC; Slurry Transport Assoc. (1983). (CONF-830350—). Contract AC22-81PC42265.

From 8. international technical conference on slurry transport; San Francisco, CA, USA (15 Mar 1983).

In many materials handling operations in the minerals industry, coarse particles are preferred to alleviate dusting and to lower preparation and separation costs, particularly for hydrotransport systems. It is well known that slurries of large, dense particles require more power for hydrotransport than small, light particles. In the case of coal with its relatively low density the power requirements are not as high but neither is the payload (tons/hr). Rather large particles at high solids concentration must be transported to effect reasonable payloads. The objective of this program was to perform benchscale mixing tests to define the mechanisms by which enlightened slurries are formed. These tests were supplemented by microscopic examinations of the slurries to determine how enlightenment occurs. Pumping tests were then performed to demonstrate and evaluate the hydrotransport characteristics of an enlightened coarse coal slurry. Slurry samples taken from the pipeloop tests were examined microscopically. Due to the extensiveness of the program only the pumping tests and microscopy work will be discussed in this paper.

24594 **An experimental investigation of interfacial shear in large particle coal hydrotransport.** Barnhart, J.S.; Eyler, L.L.; Lombardo, N.J.; Shupe. (Pacific Northwest Laboratory, Richland, WA). pp 17-23 of Slurry transporation and pneumatic handling. Hay, E. New York, NY; A.S.M.E. (1982). (CONF-821101—).

From ASME winter annual meeting (Engineering applications of laser velocimetry/published in ASME Jr. Fluid Engineering); Phoenix, AZ, USA (14 Nov 1982).

Recent efforts in coarse-particle hydrotransport modeling include the development of a physically-based model that separates the particles into two components--suspended load and contact load. The analyses of the two components are coupled by interfacial shear resulting from the components' differing bulk velocities. In support of these modeling efforts, the interfacial friction factor for water flowing in a pipe over well-characterized coal beds was evaluated experimentally. Experiments were conducted in a 32.5-m long, 16.5-cm I.D. Plexiglas pipe. Coal samples of d/D = 0.05, 0.10, and 0.20 were placed inside the pipe at three different bed depths. Pressure taps at four axial locations measured the pressure drop as water flowed over the bed. This paper describes the apparatus, experimental and data-reduction procedures, and the results achieved. A correlation of interfacial friction factor in terms of average particle diameter suitable for modeling purposes is presented.

24595 **Analytical modeling of large particle coal hydrotransport.** Eyler, L.L.; Lombardo, N.J. (Pacific Northwest Laboratory, Richland, WA). pp 9-15 of Slurry transportation and pneumatic handling. Hay, E. New York, NY; A.S.M.E. (1982). (CONF-821101—).

From ASME winter annual meeting (Engineering applications of laser velocimetry/published in ASME Jr. Fluid Engineering); Phoenix, AZ, USA (14 Nov 1982).

Interactive flow phenomena have been analyzed to support the mechanistic force balance modeling approach to large particle hydrotransport. Particular emphasis is given to analyzing particle saltation and suspension criteria and to physical modeling of interfacial shear and throughbed flow. The force balance modeling approach has previously been concluded to offer the best physical basis for scaleup calculation of large particle hydrotransport pressure drop and lower limits of operation. Improvements are still needed, however, in describing large particle suspension transition for d/D > 0.05. Alternative approaches to modeling interfacial shear are discussed and results presented. Available data are insufficient to conclude which approach is most adequate. Throughbed flow was investigated experimentally and concluded to be negligible under certain conditions. The dependence of physical parameters in the force balance model approach on sliding friction, loose packed bed fraction, and specific gravity are discussed as well as operating parameters such as delivered concentration, particle size, and pipe size.

24596 **Economics and technology of major existing and proposed coal-transport systems.** *Mining Congress Journal;* 64: No. 1, 12(Jan 1978).

Economics and technology of major existing and proposed coal-transport systems are compared in a new report from the U.S. Department of Energy and the U.S. Bureau of Mines prepared by the University of Illinois under a $75,000 contract. Existing barge and rail systems and proposed slurry pipeline systems can all carry coal over long distances for less than $0.02/ton-mi. For given origins and destinations, the system or combination which is most practical depends on availability of routes, compatibility between systems, unloading-loading costs, and other economic and engineering factors. The report describes how each transport system works and tabulates cost elements for each, with detailed investment, operating, and maintenance cost estimates for coal transport. The title of the report is "Comparative Coal Transportation Costs: An Economic and Engineering Analysis of Truck, Belt, Rail, Barge and Coal Slurry and Pneumatic Pipelines".

24597 **Coal transport costs studied.** *Chemical and Engineering News;* **55**: No. 49, 20(5 Dec 1977).

Existing barge and rail systems and proposed slurry pipeline systems all can carry coal over long distances for less than $0.02/ton-mi, according to a study of the economics and technology of major existing and proposed coal transport systems carried out by the University of Illinois for the U.S. Department of Energy and U.S. Bureau of Mines. That cost is based strictly on detailed investment, operating, and maintenance cost estimates and not on freight carriers' current rates.

0140 Combustion

REFER ALSO TO CITATION(S) 24582

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 24572, 24577, 24578, 24580, 24589, 24590, 24596

24598 (DOE/CE/40596—T1, pp 469-479) **Energy generation: nuclear vs coal.** Parate, N.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Various studies indicate that the projected increase in world electric energy demand could not be met without a major contribution from Nuclear Power. Nuclear industry has been clouded with uncertainties during recent years particularly in United States. Most of the developing world is deprived of sufficient reserves of coal. More than 80% of world's coal is in USSR & USA. The real advantage of the nuclear power is the low cost of fuel and clean environment. The various experiences of electric utilities in USA are presented and discussed in the paper. The Nuclear industry advocates argue that the nuclear energy is clean, cheap and safe with unlimited available fuel source but the opponents argue about the environmental damage, riskfactors, waste disposal and decommissioning issues as well as the recent power plant operational & design issues echoed by the Nuclear Regulatory Commission. 19 references, 7 figures, 7 tables.

24599 **(DOE/RA/50348—T1-Vol.2) High-Btu gas from peat. Feasibility study. Volume II. Executive summary.** (Minnesota Gas Co., Minneapolis (USA)). 1984. Contract FG01-80RA50348. 354p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84005555.

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In September 1980, the US Department of Energy awarded a grant to the Minnesota Gas Company (Minnegasco) to evaluate the commercial, technical, economic, and environmental viability of producing 80 million Standard Cubic Feet per day (SCF/day) of substitute natural gas (SNG) from peat. Minnegasco assigned the work for this study to a project team consisting of the following organizations: Dravo Engineers and Constructors for the design, engineering and economic evaluation of peat harvesting, dewatering, and gasification systems; Ertec, Inc. for environmental and socioeconomic analyses; Institute of Gas Technology for gasification process information, and technical and engineering support; and Deloitte Haskins & Sells for management advisory support. This report presents the work performed by Dravo Engineers and Constructors to meet the requirements of: Task 1, peat harvesting; Task 2, peat dewatering; Task 3, peat gasification; Task 4, long lead items; and Task 9.1, economic analysis. The final report comprises three volumes, the first is the Executive Summary. This Volume II contains all of the text of the report, and Volume III includes all of the specifications, drawings, and appendices applicable to the project. Contents of Volume II are: introduction; project scope and objectives; commercial plant description; engineering specifications; design and construction schedules; capital cost estimates; operating cost estimates; financial analysis; and future areas for investigation. 15 figures, 17 tables.

24600 **(DOE/RA/50348—T4) High Btu gas from peat. Existing social and economic conditions.** (Ertec Atlantic, Inc., Somerset, NJ (USA)). Aug 1981. Contract FG01-80RA50348. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84005561.

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In 1980, the Minnesota Gas Company (Minnegasco) submitted a proposal to the US Department of Energy entitled, A Feasibility Study - High Btu Gas from Peat. The proposed study was designed to assess the overall viability of the design, construction and operation of a commercial facility for the production of high-Btu substitute natural gas (SNG) from Minnesota peat. On September 30, 1980, Minnegasco was awarded a grant by the Department of Energy to perform the proposed study. In order to complete the study, Minnegasco assembled an experienced project team with the wide range of expertise required. In addition, the State of Minnesota agreed to participate in an advisory capacity. The items to be investigated by the project team during the feasibility study include peat harvesting, dewatering, gasification process design, economic and risk assessment, site evaluation, environmental and socioeconomic impact assessment. Ertec (The Earth Technology Corporation) was selected to conduct the site evaluation and environmental assessment portions of the feasibility study. The site evaluation was completed in March of 1981 with the submittal of the first of several reports to Minnegasco. This report describes the existing social and economic conditions of the proposed project area in northern Minnesota. The baseline data presented will be used to assess the significance of potential project impacts in subsequent phases of the feasibility study. Wherever possible, the data base was established using 1980 Bureau of Census statistics. However, where the 1980 data were not yet available, the most recent information is presented. 11 figures, 46 tables.

24601 **(DOE/RA/50348—T1-Vol.1-Exec.Summ.) High-Btu gas from peat. Feasibility study. Volume I. Executive summary.** (Minnesota Gas Co., Minneapolis (USA)). 1984. Contract FG01-80RA50348. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84005558.

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In September, 1980, the US Department of Energy awarded a grant to the Minnesota Gas Company (Minnegasco) to evaluate the commercial, technical, economic, and environmental viability of producing 80 million Standard Cubic Feet per day (SCF/day) of substitute natural gas (SNG) from peat. Minnegasco assigned the work for this study to a project team consisting of the following organizations: Dravo Engineers and Constructors for the design, engineering and economic evaluation of peat harvesting, dewatering, and gasification systems; Ertec, Inc. for environmental and socioeconomic analyses; Institute of Gas Technology for gasification process information, and technical and engineering support; and Deloitte Haskins & Sells for management advisory support. This report presents the work performed by Dravo Engineers and Constructors to meet the requirements of: Task 1, peat harvesting; Task 2, peat dewatering; Task 3, peat gasification; Task 4, long lead items; and Task 9.1, economic analysis. The final report comprises three volumes, the first of which is this Executive Summary. Subsequent volumes include Volume II which contains all of the text of the report, and Volume III which includes all of the specifications, drawings, and appendices applicable to the project. As part of this study, a scale model of the proposed gasification facility was constructed. This model was sent to Minnegasco, and photographs of the model are included at the end of this summary.

02 PETROLEUM

0202 Geology And Exploration

24602 **(DOE/RA/50653—T1) Field demonstration on unconventional methods in exploration for petroleum and natural gas. Phase I. Final report on feasibility study.** Heroy, W.B. Jr. (Southern Methodist Univ., Dallas, TX (USA)). 10 Mar 1982. Contract AC01-81RA50653. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010649.

It is concluded that the FIELD DEMONSTRATION is feasible at a cost of seven to eight million dollars and three to four years. Successful completion of Phase II promises near term returns of an unusually high order of magnitude. Even marginal success promises to provide economic benefits, as well as possible political benefits, all out of proportion to the cost involved. It appears that the most certain means of achieving Phase II (despite the long delay anticipated) lies in the Department of Energy requesting the National Academy of Science to analyze the utility to the Nation of the FIELD DEMONSTRATION. It is this recommendation which is the specific product of the Phase I feasiblity study.

24603 **Geological fracture mapping using electromagnetic geotomography.** Ramirez, A.L.; Deadrick, F.J.; Lytle, R.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). pp 1055-1064 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This article describes the evaluation of a new geophysical technique used to map fractures between boreholes: electromagnetic geotomography used in conjunction with salt water tracers. An experiment has been performed in a granitic rock mass. Geotomographic images have been generated and compared with borehole geophysical data: neutron logs, acoustic velocity logs, caliper logs and acoustic televiewer records. Comparisons between the images and the geophysical logs indicate that clusters of fractures were detected but single fractures were not.

0207 Marketing And Economics

24604 (DOE/CE/40596—T1, pp 465-467) **Oil price forecasting.** Morris, H.N. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Historically, OPEC inherited the pricing structure that had been devised by the major oil companies and the international oil market. In order to overcome the problems of establishing the market price of crude, while protecting revenue against inflationery erosion, OPEC has developed a production sharing system for the international market.

0208 Waste Management

24605 **Surface spectroscopic study of sulfided molybdena-alumina catalysts.** Li, C.P.; Hercules, D.M. (Univ. of Pittsburgh, PA). *Journal of Physical Chemistry;* **88**: No. 3, 456-464(2 Feb 1984). Contract AC02-79ER10485.

X-ray photoelectron spectroscopy (ESCA), low-energy ion-scattering spectroscopy (ISS), and X-ray diffraction have been used to characterize a series of sulfided and reduced $MoO_3/\gamma\text{-}Al_2O_3$ catalysts. X-ray diffraction has shown the presence of small MoS_2 crystallites on a catalyst prepared by impregnation of ammonium thiomolybdate in γ-alumina with subsequent calcination. ESCA and ISS have identified the presence of both MoS_2 and Mo(V) on a $MoO_3/\gamma\text{-}Al_2O_3$ catalyst sulfided with 15% H_2S/H_2. The octahedrally and tetrahedrally coordinated molybdenum on an oxidic $MoO_3/\gamma\text{-}Al_2O_3$ precursor catalyst show different sulfidation behavior. At low Mo concentrations, tetrahedrally coordinated molybdenum is reduced mostly to Mo(V) and only partially sulfided to MoS_2. Increasing the MoO_3 loading above 8% MoO_3 caused formation of excess octahedrally coordinated molybdenum which leads to a significant increase of MoS_2 on the sulfided catalyst. After monolayer coverage has been reached, formation of $Al_2(MoO_4)_3$ and MoO_3 result in prominent MoS_2 formation and a small amount of Mo(V) on the sulfided catalyst. The effect of calcination temperature has been studied; it was found that decreased calcination temperatures favor formation of MoS_2 on sulfided $MoO_3/\gamma\text{-}Al_2O_3$ catalysts.

0209 Environmental Aspects

24606 **(DOE/PO/10850—2-Vol.1) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Volume I. Appendices. Annual report for the Bryan Mound Site, September 1982-August 1983.** (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1984. Contract AC96-83PO10850. 517p. NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE84010693.

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The Department of Energy's Strategic Petroleum Reserve Program began leaching the Bryan Mound salt dome and discharging brine into the coastal waters offshore of Freeport, Texas on March 10, 1980. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the Bryan Mound brine discharge on the marine environment. The study addresses the areas of physical oceanography, analysis of the discharge plume, water and sediment quality, nekton, benthos and data management. It focuses on the period from September 1982 through August 1983. The ambient physical environment and its temporal and spatial variability were studied by means of continuously recording in situ current/conductivitiy/temperature meters and twelve, one-day synoptic hydrographic cruises. The quarterly water and sediment quality data show a small increase in salinity, sodium and chloride ions occurs in the bottom waters and sediment pore waters near the diffuser relative to those values measured at stations farther away. Data from the brine plume study for this reporting study show the largest areal extent within the +1 o/oo above ambient salinity contour was 40.0 km^2 which occurred on August 11, 1983. It appears that brine disposal at Bryan Mound has had neglible if any influence on the nekton community surrounding the diffuser. The benthic quarterly data from 26 stations, including 7 collections made after the diffuser outflow rate was increased to 1,000,000 barrels/day, show the total numbers of species at the diffuser station were higher than most other nearfield stations as well as many farfield stations in both the pre- and post-1,000,000 barrels/day brine flow periods. 138 references, 175 figures, 53 tables.

24607 **(DOE/PO/10850—2-Vol.2) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Volume II. Appendices. Annual report for the Bryan Mound Site, September 1982-August 1983.** (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1984. Contract AC96-83PO10850. 335p. NTIS, PC A15; 3; GPO Dep. Order Number DE84010694.

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The Department of Energy's Strategic Petroleum Reserve Program began leaching the Bryan Mound salt dome and discharging brine into the coastal waters offshore of Freeport, Texas on March 10, 1980. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the Bryan Mound brine discharge on the marine environment. The study addresses the areas of physical oceanography, analysis of the discharge plume, water and sediment quality, nekton, benthos and data management. It focuses on the period from September 1982 through August 1983. Volume II contains the following appendices: (1) supporting data for physical oceanography; (2) supporting data for brine plume measurements; (3) supporting data for water and sediment quality; (4) supporting data for nekton studies; and (5) Bryan Mound discharge data. 204 figures, 69 tables.

0220 Transport, Pipelines, And Handling

24608 **DOE (U.S. Department of Energy) wins fight to keep oil-storage program on track.** *Oil and Gas Journal;* **76**: No. 2, 25(9 Jan 1978).

The U.S. Office of Management and Budget wanted to delay acquiring the last 500 million bbl of reserve called for by the 1 billion bbl strategic reserve program, but President Carter is following DOE's advice to stay on schedule. Parsons, Brinchkerhoff, Quade and Douglas Inc. has been awarded the $11.5 million project-management contract for the supervision of seven rigs to drill re-entry wells at the West Hackberry, La., and Bryan Mound, Tex., storage sites. Parsons and Kavernen Bau- und Betriebsgesellschaft m.b.H. will design surface facilities and wells to utilize present salt-dome caverns. The surface facilities are scheduled for completion by Dec. 1978, and design and installation of facilities for the emergency strategic reserve portion are scheduled for completion by mid-1978.

0230 Properties

REFER ALSO TO CITATION(S) 24933, 24945

0240 Storage

REFER ALSO TO CITATION(S) 24606, 24607

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 24602, 24603

0304 Products And By-products

24609 **Continuing US helium saga.** Hammel, E.F.; Krupka, M.C.; Williamson, K.D. Jr. (Los Alamos National Lab., NM). *Science (Washington, D.C.);* **223**: 789-792(24 Feb 1984).

Helium, resident in relatively high concentrations in certain natural gas fields in the United States, can be lost to the atmosphere when the natural gas is burned as fuel. In 1960, Congress amended the Helium Act of 1925 to provide for stripping natural gas of its helium, for purchase of the separated helium by the government, and for its long-term storage. In 1971, after about 28 billion cubic feet had been stored, the purchase program was terminated by the government, an action that unleashed several lawsuits and not a little acrimony. After more than a decade of controversy, much of the litigation has been concluded, much of the helium that could have been saved has been wasted to the atmosphere, and the gas fields supplying the helium are almost depelted. A new rich source of helium has been discovered in southwestern Wyoming (at least 200 bcf recoverable) that could ensure adequate supplies for many decades if an appropriate new federal policy on helium is developed and implemented. 18 references.

0340 Combustion

REFER ALSO TO CITATION(S) 24656, 25002, 25004

24610 (BNL—51714, pp 222-223) **New CARS capability in the CRF.** Farrow, R.L.; Layne, C.B. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24611 (BNL—51714, pp 233-235) **Numerical solution of a confined laminar diffusion flame.** Smooke, M.D.; Mitchell, R.E.; Grcar, J.F. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

24612 (DOE/CE/40596—T1, pp 431-439) **Outlook for liquid fuels from shale oil.** Gupta, V.K. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The availability of oil shale, the nature of the oil shale, the comparison of various technologies of extracting oil from the rock, upgrading the oil, and it environmental and social impact are covered. An effort was also made to point out the future trends and prospects of Shale Oil industry in the US. (MHR)

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 24621

24613 **(DOE/ET/14363—T14) Concentration of oil shale by froth flotation. Monthly technical letter report, April 1-30, 1983.** Krishnan, G. (SRI International, Menlo Park, CA (USA)). 28 Jul 1983. Contract AC01-80ET14363. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010819.

Highlights of progress during April 1983 are sumarized. The purpose of the investigation was to determine whether the fine shale particles produced during crushing can be upgraded by froth flotation. The Anvil points shale was crushed in a jaw crusher followed by pulverizing in a disintegrator. The pulverized shale with a top particle size of 0.05 cm was separated into three size fractions. The results of flotation with these fractions are shown. The results indicated that upgrading is possible with the relatively coarse particles (> 100 μmm). However the kerogen content of the concentrate and the recovery of kerogen were considerably less with the dry pulverized shale than with the wet ground shale for the same particle size range. The fine particles (< 100 μm,) obtained from pulverizing were highly hydrophobic and could not be wetted easily; they tend to float on the water rather than sink unless severely agitated mechanically. During froth flotation most of the shale particles ended up in the concentrate (froth) resulting in no upgrading. These observations indicate the fines produced during crushing operations can be upgraded by froth flotation except when they are extremely fine.

24614 **(DOE/ET/14363—T15) Concentration of oil shale by froth flotation. Monthly technical letter report, May 1-31, 1983.** Krishnan, G. (SRI International, Menlo Park, CA (USA)). 14 Oct 1983. Contract AC01-80ET14363. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010818.

Highlights of findings during May 1983, are briefly summarized. Batches of shale were ground in a 14-inch ball mill. Froth flotation of the ground shales were carried out using pine oil as a frother. Shale used was a high grade eastern shale (New Albany shale). (DMC)

24615 **(DOE/ET/14363—T16) Concentration of oil shale by froth flotation. Monthly technical letter report, June 1-30, 1983.** Krishnan, G. (SRI International, Menlo Park, CA (USA)). 14 Oct 1983. Contract AC01-80ET14363. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010821.

During the month of June we continued with the study of froth flotation of New Albany shale. Because the shale particles were not reduced sufficiently to literate organics and inorganics by the use of 3.8 cm diameter balls (as grinding medium) we used 1.3 cm diameter balls. The smaller diameter balls are more efficient in grinding fine particles. However, the 1.3 cm diameter balls were not effective in grinding the large particles of the feed shale. Hence, we initially used 3.8 cm diameter balls and then 1.3 cm diameter balls. As previously observed, the fractions of organics in the feed shale recovered in the concentrate were very high, in

excess of 95%. The grade or fraction of organics in the concentrate increased steadily, indicating increased liberation with increased grinding time. A factor of two increase in the grade was observed at the end of 26 hours of grinding. The Minerals Separation Corporation has completed the dynamic heavy media testing of Tract C-A shales.

24616 **(DOE/ET/14363—T17) Concentration of oil shale by froth flotation. Monthly technical letter report, July 1-30, 1983.** Krishnan, G. (SRI International, Menlo Park, CA (USA)). 14 Oct 1983. Contract AC01-80ET14363. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010820.

During the month of July we concentrated on improving the organic fraction of flotation concentrates of New Albany shales. During flotation the concentrates were collected in batches as a function of time and they were analyzed for their organic fraction. During the initial 5 minutes approximately 33% of organics in the feed shale were recovered and the organic fraction (grade) of this batch was almost twice that of the feed shale. With increasing flotation time more organics were recovered, but the grade was smaller. At about 20 minutes of flotation time with 90% recovery, the concentrate grade was 25.7% organics. Additional time increased the recovery only marginally, but the grade decreased considerably. In order to improve the grade of the concentrate, we ground the concentrates in a ball mill for an additional 6 hours and then subjected to froth flotation. During the first 10 minutes about 62% of the organics in the feed shale were recovered in the concentrate and the grade of this concentrate was 39.0% organics. Continuing the flotation for another fifteen minutes improved the recovery to 95%, but decreased the grade somewhat (32.4). As in the first stage of flotation the tailings were low in organics.

24617 **(LA-UR—84-871) Results from some oil shale fragmentation experiments conducted at the Anvil Points Mine, Colorado.** Dick, R.D. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 12p. (CONF-840633—10). NTIS, PC A02; 3; GPO Dep. Order Number DE84010058.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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The Los Alamos National Laboratory was involved in an oil shale fragmentation research program in cooperation with a Consortium of industrial companies to investigate the feasibility of using modified in-situ (MIS) recovery of oil from oil shale. Field tests were conducted at the Anvil Points Mine, Colorado, in the thick oil shale beds of the Green River formation. Part of the program included obtaining data about fragmentation by instrumenting the tests with accelerometers, velocity gauges, and the CORRTEX technique (Continuous Reflectometry for Radius versus Time Experiments). Some of the rock motion data from accelerometer and velocity gauges is presented, along with some conclusions. In addition, the signal recording system is briefly explained. The CORRTEX technique is discussed, and some results on explosive performance and stem behavior using the method are discussed.

24618 **(SAND—83-2650) Oil shale pilot retorting experiment summaries: permeability contrast runs 38, 39 and 40.** Tyner, C.E.; Cook, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010681.

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To distinguish oil yield loss mechanisms caused by non-uniform permeability distributions in an oil shale retort from those caused by other factors (particle size, grade, or operating conditions), a series of 100-kg adiabatic pilot retorting experiments were conducted with deliberate axisymmetric permeability contrasts introduced during bed loading as the only variable. Three experiments have been conducted to date: a base case with no permeability contrast and two runs with 3:1 permeability contrasts. This paper documents the experimental system, operating conditions, and results, including detailed tabulation of all data. In these experiments increasing delays in heating (and thus retorting) within the lower-permeability zone was observed as a function of increasing contrast between the permeabilties of the two zones in the retort. This results directly in increased oil combustion and cracking losses ($\sim$ 20% versus $\sim$ 10% for a uniform base case) because of increased overlap of retorting and combustion zones. Corresponding decreases in thermal efficiency and char utilization were also observed. These data have shown that multi-dimensional studies are required to analyze in situ retorts accurately by demonstrating conclusively that local yield losses (not just sweep inefficiencies) can be introduced solely by permeability contrasts. Conversely, it appears that local yield as well as sweep efficiency may be significantly improved by creating more uniform rubble beds.

24619 **(UCRL—89805-Rev.1) General model of oil shale pyrolysis. Revision 1.** Burnham, A.K.; Braun, R.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 18p. (CONF-840415—7-Rev.1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008991.

From 187. national meeting of the American Chemical Society; St. Louis, MO, USA (8 Apr 1984).

A mathematical model for pyrolysis of Green River oil shale is developed from previous experiments on oil, water, and gas evolution and oil cracking over a wide range of pyrolysis conditions. Reactions included are evolution of 5 gas species, oil, and water from kerogen, clay dehydration, oil coking and cracking, and evolution of H_2 and CH_4 from char. Oil is treated in eleven boiling point fractions in order to treat the competition between oil coking and evaporation, and to evalute the effect of oil cracking on the boiling point distribution of the oil. The kinetics and product yields calculated by the model are compared to experimental results for pyrolysis conditions ranging from isothermal fluid-bed to high-pressure slow-heating-rate retorting.

24620 **Aromatic hydrocarbons obtained by thermal conversion of Green River oil shale kerogen using CO and H_2O at elevated pressure.** Chong, S.L.; Heppner, R.A. (Laramie Energy Technology Center, WY). *Liquid Fuels Technology;* 1: No. 2, 67-88(1983).

Aromatic hydrocarbons produced from the reaction of Green River oil shale with carbon monoxide and water at elevated pressure and at temperatures from 300 to 450°C were investigated. The isolation of these aromatic hydrocarbons involved ion exchange, complexation, silica gel, and alumina chromatographic techniques. Compound types present in these aromatic hydrocarbons were studied by high resolution mass spectrometry and combined gas chromatography-mass spectrometry. Compound types were mostly phenylcyclohexylakanes, and carotenoid types at 300°C; but at 450°C compound types were mostly alkylbenzenes, alkybiphenyls, and alkynaphthalenes. The composition of aromatic hydrocarbons from the benzene-extracted bitumen of Green River oil shale was found to be similar to that in the 300°C product from the CO-H_2O reaction. 19 references, 4 figures, 5 tables.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 24620, 25097

24621 **Investigation of waxes isolated from heavy oils produced from Northwest Asphalt Ridge tar sands.** Branthaver, J.F.; Thomas, K.P.; Dorrence, S.M.; Heppner, R.A.; Ryan, M.J. (Univ. of Wyoming Research Corp., Laramie). *Liquid Fuels Technology;* 1: No. 2, 127-146(1983).

During the late 1970's, the Laramie Energy Technology Center operated two in-situ combustion projects in the Northwest Asphalt Ridge tar sand deposit of Utah. Some of the heavy oils produced were observed to have high pour points, which resulted in handling problems in cold weather. These heavy oils contain waxes, which were found to be n-alkane homologues ranging past carbon number 60. These alkanes seem to have been derived from what are probably Ozokerite veins, which are found in the tar sand deposit. Samples from these veins and waxes derived from produced heavy oils were studied using ^{13}C NMR, IR, and chemical ionization mass spectrometry.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 24797

05 NUCLEAR FUELS

0502 Exploration

REFER ALSO TO CITATION(S) 25059

0504 Feed Processing

24622 **(DP—1661) Laboratory-scale catalysis studies of uranium and plutonium fluorination reactions by solid metal-fluorides.** Hochel, R.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1984. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010621.

Various catalysts were evaluated for their effect on the rate of fluorination of the tetrafluorides of uranium and plutonium to produce the hexafluorides. Results of this work show that CoF_3 and AgF_2 are more effective than NiF_2 for UF_4 fluorination, producing rate increases in the range of 150 to 300 compared to UF_4 and fluorine alone. The use of these three catalysts was also found effective in the fluorinations of PuO_2/PuF_4 and pure PuF_4. However, enhancements were less. NiF_2 produced the best increases which were 8.1 for PuO_2/PuF_4 and 3.6 for PuF_4. Experiments were conducted in a simple flow-loop. Even larger enhancements might be obtained with fluidized beds. Details of the apparatus, experiments, methods, and a discussion of results are presented.

0505 Enrichment

24623 **(K/OA—5609) Semiportable load-cell-based weighing system prototype of 18.14-metric-ton (20-ton) capacity for UF_6 cyclinder weight verifications: description and testing procedure.** McAuley, W.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 13 Apr 1984. Contract AC05-84OT21400. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010559.

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The 18.14-metric-ton-capacity (20-ton) Load-Cell-Based Weighing System (LCBWS) prototype scheduled to be tested at the Oak Ridge (Tennessee) Gaseous Diffusion Plant March 20-27, 1984, is semiportable and has the potential for being highly accurate. Designed by Brookhaven National Laboratory, it can be moved to cylinders for weighing as opposed to the widely used operating philosophy of most enrichment facilities of moving cylinders to stationary accountability scales. Composed mainly of commercially available, off-the-shelf hardware, the system's principal elements are two load cells that sense the weight (i.e., force) of a uranium hexafluoride (UF_6) cylinder suspended from the LCBWS while the cylinder is in the process of being weighed. Portability is achieved by its attachment to a double-hook, overhead-bridge crane. The LCBWS prototype is designed to weigh 9.07- and 12.70-metric ton (10- and 14-ton) UF_6 cylinders. A detailed description of the LCBWS is given, design information and criteria are supplied, and testing procedures are outlined. A major objective of the testing is to determine the reliability and accuracy of the system. Other testing objectives include the identification of: (1) potential areas for system improvements; and (2) procedural modifications that will reflect an improved and more efficient system. Testing procedures described include, but are not limited to, methods that account for the temperature sensitivity of the instrumentation, the local variation in the acceleration due to gravity, and buoyancy effects. Operational and safety considerations are noted. 7 references, 11 figures, 8 tables.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 24632, 24633

24624 **(CONF-840614—10) Helium/solid powder O-ring leakage correlation experiments using a radiotracer.** Bild, R.W.; Leisher, W.B.; Weissman, S.H.; Seya, M. (Sandia National Labs., Albuquerque, NM (USA); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1984. Contract AC04-76DP00789. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005518.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

UO_2 definitely leaked past the O-ring in three of the tests confirming the major results of the previous work. Continuous leakage at these levels may require additional precautions under present regulatory policies. The mechanism and the time and particle size dependence for the leakage are not known, but there is some indication leakage is more likely at low temperatures. It is possible leakage is due to movement of the O-ring during temperature or pressure cycling at the beginning or end of a test. The radiotracer method involves less labor and is much less susceptible to contamination than the previous method. Future work will investigate leakage past lubricated O-rings and time dependence of leakage. 1 reference, 1 table.

24625 **(SAND—84-0034C) Assessment of the response of spent fuel transports to malevolent acts.** Sandoval, R.P. (Sandia National Labs., Albuquerque, NM (USA)). 20 Dec 1983. Contract AC04-76DP00789. 7p. (CONF-840614—11; TTC—0468). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005552.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

This paper describes the results of a program conducted at Sandia National Laboratories (SNL) for the US Department of Energy to provide an experimental data base for more accurately assessing the radiological consequences from a hypothetical sabotage attack on a spent fuel shipping cask. The primary objectives of the program were limited to: (1) evaluating the effectiveness of selected high explosive devices (HED) in breaching full-size spent fuel casks, (2) quantifying and characterizing relevant aerosol properties of the released fuel, and (3) using the resulting experimental data to evaluate the radiological health consequences resulting from a hypothetical sabotage attack on a spent fuel shipping cask in a densely populated area. Subscale and full-scale experiments in conjunction with an analytical modeling study were performed to meet the programmatic objectives. The data from this program indicate that the Urban Studies greatly overestimated the impact of malevolent acts directed at spent fuel casks in urban environs. From that standpoint this work could be the basis of additional regulatory revisions of the NRC physical protection requirements. In a larger sense this work can also be the basis of more credible worst case analyses since it defines the actual result of an event which is well beyond any expectations of cask failures in accident environments. 5 references.

24626 **(SAND—84-0755C) Research and development at the Transportation Technology Center.** Wowak, W.E. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 16p. (CONF-8404127—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009922.

From INMM packaging and transportation seminar; Washington, DC, USA (17 Apr 1984).

A research and development program has been implemented at the Transportation Technology Center to support the design and certification of nuclear material transportation systems. The overall program includes activities in standards and subsystems development, systems development, information materials and systems, institutional issue analyses, and safety analyses. The status of some of the activities in the standards and subsystems development and systems development is reviewed in this paper. Specifically, the programs on torch and engulfing pool fires, computer code evaluation, target hardness and materials technology are described briefly. The

future direction of these five programs is outlined. 8 references, 1 figure.

24627 **Predicting transport requirements for radioactive waste slurries.** Motyka, T.; Randall, C.T. (E.I. du Pont de Nemours & Company). pp 81-87 of Proceedings of Eighth International Technical Conference on Slurry Transportation. Washington, DC; Slurry Transport Assoc. (1983). (CONF-830350—). Contract AC09-76SR00001.

From 8. international technical conference on slurry transport; San Francisco, CA, USA (15 Mar 1983).

The Savannah River Plant (SRP) is presently the nation's primary source of tritium, weapons plutonium, heat source plutonium, deuterium and several other radionuclides for defense, space, medical, and energy applications. The SRP site includes a nuclear fuel fabrication plant, three production reactors, two fuel reprocessing plants and high level waste storage facilities. Plans are also underway to construct and operate the Defense Waste Processing Facility (DWPF) which will be the nation's first large-scale facility for immobilizing high level radioactive waste in a borosilicate glass. Presently, high-level radioactive waste is generated from the chemical reprocessing of irradiated fuel and target elements. The waste is neutralized and stored in large underground carbon steel tanks as an alkaline liquid along with a precipitated hydroxide sludge. Current DWPF plans call for the transport of this neutralized waste from the two existing tank farm areas to the DWPF processing site. A two-mile-long transfer line, originally designed and used only for waste salt solution transfers, runs between the two high-level waste tank farms. This line is now being considered for waste sludge slurry service. This paper examines the methods that were used to predict the operating conditions needed to successfully pump the radioactive waste sludge slurry through the existing transfer line. Bench-scale experiments were performed to characterize the actual waste and to create a synthetic waste for pipeline tests. The results of these tests are discussed along with basic design recommendations.

0520 Waste Management

REFER ALSO TO CITATION(S) 24636, 24636, 24904, 24921, 25112

24628 **(BMI-X—701) Environmental geochemistry of chelating agents and radionuclide - chelate complexes. Final report.** Means, J.L.; Alexander, C.A. (Battelle Columbus Labs., OH (USA)). 28 Oct 1980. Contract W-7405-ENG-92. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010690.

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The disposal of chelated radioactive waste is discussed. Chelating agents are used in decontamination because they form very selective and strong complexes with nuerous radionuclides. However, if environmentally-persistent chelated wastes are disposed without pretreatment to eliminate the chelating agents, increased radionuclide migration rates from the disposal sites may occur. The environmental chemistry of the three most common aminopolycarboxylic acid chelating agents, NTA (nitrilotriacetic acid), EDTA (ethylenediaminetetraacetic acid), and DTPA (diethylenetriaminepentaacetic acid) is reviewed. Increased solubility and/or migration of radionuclides by chelating agents used in decontamination operations have been observed at two different radioactive waste burial grounds, Oak Ridge and Maxey Flats. These observations suggest that the practice of disposing chelated radioactive wastes should be re-evaluated. Three different technical options for disposing chelated low-level radioactive wastes are proposed: (1) bind the solidified chelated waste in some kind of polymeric organic matrix that has a slow each rate and bury the waste in a dry disposal site; (2) substitute biodegradable chelating agents in the decontamination reagent for the chelating agents that are persistent in the environment; and (3) chemically or thermally degrade the chelating agents in the waste prior to disposal. We feel that surprisingly little attention has been given to an obvious procedure for the disposal of chelated radioactive wastes: chemically or thermally degrading the chelating agent prior to disposal. Any of the above three options might in fact be a satisfactory approach to the disposal of chelated wastes. However, we suggest that the burial of chelating agents such as EDTA be avoided and that option (3) be given more consideration. 100 references, 6 figures, 4 tables.

24629 **(DOE/ID/12512—T1) Detailed test plan on co-disposal of deminumum levels of LLRW and sanitary waste.** Chian, E.S.K. (Georgia Inst. of Tech., Atlanta (USA). Support Services Div.). 1984. Contract FG07-84ID12512. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010808.

The major objectives of this investigation are: (1) to study the attenuation mechanisms for radionuclides (LLRW) in simulated sanitary landfills with and without leachate recycle; and (2) to determine the complexation potential of ligands (viz., sulfides, humic substances) present in the leachate during different stages of landfill stabilization. Since the major emphasis of this research is on containment and isolation of LLRW within a sanitary landfill the following key elements have been incorporated into the design of the simulated pilot-scale sanitary landfills: (1) containment of LLRW within the landfills by placing the municipal refuse and LLRW in polymeric membrane-lined cells (30-mil, HDA, Gundline liner, Gundle, TX) with a leachate collection system; (2) enhancement of stabilization by leachate recycle; and (3) recovery of the gas produced from the sanitary landfills. The proposed research program addresses the fate of LLRW in municipal sanitary landfills thereby, establishing a data base to predict radionuclide pathways in sanitary landfills and to aid in assessing the environmental impacts of codisposal of LLRW within sanitary landfills. The outcome of this study may also serve to alleviate the current concern of unnecessary filling of limited space in existing licensed shallow-land burial sites. 4 figures, 1 table.

24630 **(DP-MS—83-32) Response of a glass melter to steam explosion.** Yau, W.F.; Durant, W.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 9p. (CONF-840686—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008189.

From 2. international conference on computational methods and experimental methods; New York, NY, USA (27 Jun 1984).

As part of the safety assessment in the design of the glass melter for large-scale immobilization of high-level radioactive wastes, structural considerations of the containment shell include its dynamic responses to abnormal loading conditions such as that caused by a steam explosion. The postulated steam explosion, conservatively given an energy content equivalent to 13 pounds of TNT, is capable of exerting sudden pressures greater than 300 psi but less than 410 psi on the melter wall. By use of thin-shell theory, the equations of motion satisfying the discontinuity conditions at junctions of shells with different curvatures are solved analytically. Results of stress analysis ensure elastic responses of the containment structure of the melter. 6 references, 3 figures, 1 table.

24631 **(UCRL—53462) Basalt nuclear-waste repository remote sensing using electromagnetic techniques.** Daily, W.D.; Buettner, H.M. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

The electromagnetic permittivity and attenuation rate of basalt, from the Near Surface Test Facility of the Basalt Waste Isolation Project at Hanford, Washington, have been measured in the laboratory as a function of water content at frequencies from 25 MHz to 1000 MHz. Both the permittivity and the attenuation rate are strongly related to water content of basalt in this frequency range. Completely dehydrated, the rock has a frequency-independent relative permittivity of about 8 and attenuation rates (inverse skin depths) of 0.04 m^{-1} and 3.2 m^{-1} at 25 MHz and 1000 MHz, respectively. When completely saturated by tap water to 6% by volume, the relative permittivity ranges from 16.5 to 10.0 and the attenuation ranges from 0.3 m^{-1} to 5.5 m^{-1} between 25 MHz and 1000 MHz. The data indicate that high-frequency electromagnetic remote sensing techniques, such as those used in radar, cross-borehole tomography, and borehole logging, may be useful in characterizing proposed basalt repositories and monitoring established waste repositories. Electromagnetic methods are particularly suited to delineating water content of the rock and, when completely saturated, crack and pore porosity of the rock mass within a repository. 7 references, 3 figures.

24632 **(WTSD-TME—010) Monitored Retrievable Storage conceptual system study: metal storage casks.** Unterzuber, R.; Cross, T.E.; Krasicki, B.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Waste Technology Services Div.). Aug 1983. Contract AC06-76RL01830. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010685.

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A description of the metal cask storage facility concept is presented with the operations required to handle the spent fuel or high-level wastes and transuranic wastes. A generic Receiving and Handling Facility, provided by PNL, has been used for this study. Modifications to the storage delivery side of the handling facility, necessary to couple the Receiving and Handling Facility with the storage facility, are described. The equipment and support facilities needed for the storage facility are also described. Two separate storage facilities are presented herein: one for all spent fuel storage, and one for storage of high-level waste (HLW) and transuranic waste (TRU). Each facility is described for the capacities and rates defined by PNL in the Concept Technical Performance Criteria and Base Assumptions (see Table 1.3-1). Estimates of costs and time-distributions of expenditures have been developed to construct, operate, and decommission the conceptual MRS facilities in mid-1983 dollars, for the base cases given using the cost categories and percentages provided by PNL. Cost estimates and time-distributions of expenditures have also been developed to expand the facility throughput rate from 1800 MTU to 3000 MTU, and to expand the facility storage capacity from 15,000 MTU to 72,00 MTU. The life cycle cost of the facility for the bounding cases of all spent fuel and all HLW and TRU, using the time-distributions of costs developed above and assuming a two percent per year discount rate, are also presented. 3 references, 16 figures, 18 tables.

24633 **(WTSD-TME—012) Monitored Retrievable Storage conceptual system study: tunnel drywells.** Unterzuber, R.; Cross, T.E.; Krasicki, B.R.; Lundberg, W.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Waste Technology Services Div.). Aug 1983. Contract AC06-76RL01830. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010686.

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A description of the tunnel drywell storage facility concept is presented with the operations required to handle the spent fuel or high-level wastes and transuranic wastes. A generic Receiving and Handling Facility, provided by PNL, has been used for this study. Modifications to the storage delivery side of the handling facility, necessary to couple the Receiving and Handling Facility with the storage facility, are described. The equipment and support facilities needed for the storage facility are also described. Two separate storage facilities are presented herein: one for all spent fuel storage, and one for storage of high-level waste (HLW) and transuranic waste (TRU). Each facility is described for the capacities and rates defined by PNL in the Concept Technical Performance Criteria and Base Assumptions. Estimates of costs and time-distributions of expenditures have been developed to construct, operate, and decommission the conceptual MRS facilities in mid 1983 dollars, for the base cases given using the cost categories and percentages provided by PNL. Cost estimates and time-distributions of expenditures have also been developed to expand the facility throughput rate from 1800 MTU to 3000 MTU, and to expand the facility storage capacity from 15,000 MTU to 72,000 MTU. The life cycle cost of the facility for the bounding cases of all spent fuel and all HLW and TRU, using the time-distributions of costs developed above and assuming a two percent per year discount rate, are also presented. 2 references, 14 figures, 16 tables.

24634 **Model of continuous dispersive flow with interactive deadwater and application to gas-phase flow in rotary calciners.** Spencer, B.B. (Oak Ridge National Lab., TN); Whatley, M.E.; Watson, J.S. *AIChE (American Institute of Chemical Engineers) Journal;* **29**: No. 3, 460-466(May 1983). Contract W-7405-ENG-26.

A continuous flow model is developed which describes flow through a vessel in which the fluid undergoes axial dispersed plug flow and some of the fluid is held back in a deadwater zone. The first three moments of the concentration-time curve are related to three parameters of the model, and an equation is presented to predict the outlet concentration from the vessel as a function of time for an impulse input. The model is used to analyze experimental gas-phase residence-time distribution data collected from a small rotary calciner operated at room temperature. These data are well represented by the model. 11 references, 9 figures, 1 table.

24635 **Evaluation of lutetium for volumetric calibration by isotope dilution mass spectrometry.** Smith, D.H.; Walker, R.L.; Pritchard, C.A.; Carter, J.A. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **55**: No. 3, 578-580(Mar 1983). Contract AC06-77RL01030.

Through the choice of a suitable element, the double spike technique of isotope dilution offers a viable method for determining the quantities of fissile material in holding tanks. Lutetium was found to meet all the requirements for this determination, and a procedure for volumetric calibrations with lutetium is described. Results are presented for the expected and actual gravimetrically determined values for the concentration and weight for various samples indicating a precision of ~ 0.1%.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 24628

24636 **(DOE/EA—0082-Rev.) Environmental assessment, decontamination and decommissioning of Plutonium Fabrication Facility, Building 350. ANL-Illinois.** (Argonne National Lab., IL (USA)). 27 Sep 1979. Contract W-31-109-ENG-38. 21p. NTIS MF A01; 2; GPO Dep. Order Number DE84010473.

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The proposed action is designed to reduce or minimize the potential environmental impact of the plutonium-contaminated surplus equipment by packaging and shipping it to a DOE-managed retrievable TRU-waste storage site or a licensed commercial site. It is anticipated that the majority of the estimated 15,000 cubic feet of waste will be low-level TRU waste which will be shipped by truck to the Idaho National Engineering Laboratory site (INEL). This 15,000 cubic feet of waste, which is less than 0.005 percent of the amount of TRU waste projected to be stored at INEL through 1990, will be placed in containers that meet the 20-year integrity requirements for retrievable storage. Nonradioactive wastes will be disposed of in the onsite sanitary landfill. Non-TRU radioactive waste (approximately 1000 cubic feet) will go to a commercial site at Richland, Washington. The environmental impacts associated with the transportation of radioactive material within the United States under both normal and accidental conditions have been adequately assessed in NUREG-0170. The amount of waste shipped as a result of this action is less than 0.00001 percent of the amounts covered by NUREG-0170. As a result, there are no significant impacts expected during normal transportation activities, and none expected in the event of a transportation accident. Accidental release of plutonium contamination into the Building 350 Fabrication Area will be detected by Health Physics monitoring and surveillance. There are no liquid effluents involved as the small quantities of aqueous detergents are absorbed on rags and thus converted to solid TRU-wastes. Air, soil and water samples are collected on the Argonne site and off site for routine analyses and assessments of radioactivity levels. It is anticipated that this project will have neither an adverse nor a beneficial environmental effect.

0540 Health And Safety

REFER ALSO TO CITATION(S) 24625, 24630

24637 (LA—9911-C-Vol.1) Proceedings of the CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities. Volume I. (Los Alamos National Lab., NM (USA)). Oct 1983. Contract W-7405-ENG-36. 305p. (CSNI—83-Vol.1; CONF-830442—Vol.1). NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84003976.

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

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Separate abstracts were prepared for the papers presented in the following areas: (1) fire and explosion perspectives; (2) fire, explosion, and radioactive source terms; and (3) development and verification of codes (a) mathematical and computer simulation and (b) analytical and experimental comparisons.

24638 (LA—9911-C-Vol.2) Proceedings of the CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities. Volume II. (Los Alamos National Lab., NM (USA)). Oct 1983. Contract W-7405-ENG-36. 258p. (CSNI—83-Vol.2; CONF-830442—Vol.2). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84003977.

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

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Separate abstracts were prepared for the papers presented in the following areas: (1) experience and experimentation; (2) fire and explosion prevention, protection, and detection; and (3) application of related research.

0550 Regulations

24639 (LA-UR—84-419) Technical Area 55 Entry Control System (ECS). Beaumont, A.; Brundige, E.; DesJardin, R.; Rivera, R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 8p. (CONF-8405119—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009605.

From Carnahan conference on security technology; Lexington, KY, USA (16 May 1984).

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The exchange badge system which was used at the Plutonium Facility located in Technical Area 55 was replaced on a trial basis with an automated Entry Control System. As a result of the success of the trial system, a new system incorporating expanded features and increased reliability is being implemented. The new Entry Control System incorporates several features not previously available in relatively inexpensive entry systems. The reliability of the system is enhanced by redundant microprocessors incorporating bubble memory for nonvolatile storage of the system data base. The badge readers incorporate dual communication lines to two different controllers to further increase the total system reliability.

08 HYDROGEN

REFER ALSO TO CITATION(S) 24792

0801 Production

24640 (BNL—34493) Effect of current density on anode depolarization economics. Beller, M. (Brookhaven National Lab., Upton, NY (USA)). Feb 1984. Contract AC02-76CH00016. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010465.

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A previous study analyzed the use of oxidizable species (anode depolarizers) to reduce the voltage required for hydrogen production in electrolytic cells. Subsequent experimental work indicated that, although voltage reductions were observed, the current density also decreased markedly. The present study examines the tradeoff between reduced voltage and the increased capital cost resulting from lower current density operation. It also provides a methodology for assessing the economic impact of potentially valuable by-products generated in the depolarization process. 2 references, 2 figures, 4 tables.

24641 (CONF-830974—, pp 97-101) **Technology assessment and planning.** Beller, M. (Brookhaven National Lab., Upton, NY). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This study provides a systems analysis of the present status and future potential of various hydrogen production, storage, transmission, and use options. It concludes that research and development priorities should focus upon these options in the order stated above. Additionally, within each category selected technologies are outlined for specific research effort based upon a multi-objective analysis. In particular, hydrogen production options should stress work in the areas of high temperature electrolysis and anode depolarization. In the storage area, a variety of novel options seem amenable for investigation at reduced levels of expenditure. Transmission/distribution system requirements are also outlined.

24642 (CONF-830974—, pp 102-105) **Evaluation of high-temperature solid oxide cell technology for hydrogen production.** Maskalick, N.J. (Westinghouse Electric Corp., Pittsburgh, PA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This program comprises Phase I of a multiphase program to pursue the high-temperature solid oxide fuel cell technolog toward its use in water vapor electrolysis. The Phase I objective is to design, fabricate and test solid oxide electrolyte cells in the electrolysis mode of operation, and to establish this baseline capability under a variety of test conditions. Completion of Phase I program will permit the definition of a multi-year, comprehensive development program aimed at industrial generation of hydrogen by high-temperature water vapor electrolysis. The technology would be based on present and improved materials, processes and designs developed for the electrolyzer.

24643 (CONF-830974—, pp 112-118) **Anode depolarizers for electrolytic hydrogen production.** McBreen, J. (Brookhaven National Lab., Upton, NY). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The objective of this program is to reduce the electric energy requirements for electrolytic hydrogen production through the use of anode depolarizers. A further objective of the project is to produce useful products at the anode. An extensive study was made on the use of sub-bituminous coal as an anode depolarizer. Another approach to anode depolarizations is the use of electrochemically regenerative redox couples as anode depolarizers.

24644 (CONF-830974—, pp 119-121) **Alternative anodic reactions in water splitting.** Sarfarazi, F.; O'M Bockris, J. (Texas A & M Univ., College Station). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

An experimental program has been carried out to ascertain whether coal makes a suitable depolarizer for reducing the potential (hence electricity costs) in the production of hydrogen. Earlier work indicating a positive answer to this question has been found to be due to dissolved ferrous iron impurities. After removal of the iron, the steady state current density in hydrogen evolution with coal as a depolarizer was several milliamps cm^{-2} at 1.1 volts. This current density is too low for a practical situation. Before investigating how it may be improved, it was thought valuable to investi-

gate the anodic reaction. This was found to be at least 80% oxidation of compounds from coal.

24645 (CONF-830974—, pp 122-126) **Static Feed Electrolysis (SFE) for large scale hydrogen production.** Schubert, F.H.; Kovach, A.J. (Life Systems, Inc., Cleveland, OH). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Life Systems, Inc. under the sponsorship of the Department of Energy (DOE) and the Brookhaven National Laboratory (BNL) is completing a program to demonstrate teh inherent capability of the Static Feed Electrolysis (SFE) system to meet the hydrogen generation requirements of the BNL/DOE Chemical/Hydrogen Energy Systems Program. Several technical demonstrations of the SFE system were performed. This paper presents results obtained to date in FY83.

24646 (CONF-830974—, pp 127-130) **Status of the development of solid polymer electrolyte water electrolysis for large scale hydrogen generation.** McElroy, J.F. (General Electric Co., Wilmington, MA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

During FY 83, progress continuted at General Electric in the development of solid Polymer Electrolyte (SPE) Water Electrolysis for Large Scale Hydrogen Generation. The joint Department of Energy, Electric Utility and General Electric Company sponsored program was aimed at performance improvement and endurance demonstration. In parallel, the Electric power Research institute/Public Service Electric and Gas Program concentrated on the field evaluation of the prototype 500 standard cubic foot/h SPE system. This system has undergone approximately 4000 hours of confirmation testing of which about half has been accumulated at the Public Service Electric and Gas company plant at Sewaren, New Jersey.

24647 (CONF-830974—, pp 131-136) **Photovoltaic-electrolyzer system development at the Brookhaven National Laboratory integrated test bed for advanced hydrogen technology.** Metz, P.D. (Brookhaven National Lab., Upton, NY). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Brookhaven National Laboratory is developing an integrated test bed to illustrate advanced hydrogen technology. The first phase of this effort will investigate the use of solar energy to produce hydrogen from water via electrolysis. This will be done using a state-of-the-art photovoltaic array to power an advanced technology water electrolyzer. The goal of this work is to determine the optimal design for the photovoltaic-electrolyzer system, both with and without electrical grid connection. Eventually, the test bed will be used to investigate te use of other renewable energy options and related hydrogen technology advances. This paper describes the experimental system and integrated test bed facility now under development. Research plans for fiscal years 1983 to 1985 are outlined. Progress to date is indicated. Opportunities for international cooperation are noted.

24648 (DOE/ER/00038—2552) **Theoretical perspectives on electron transfer and charge separation events in photochemical water cleavage systems.** Kozak, J.J.; Lenoir, P.M.; Musho, M.K.; Tembe, B.L. (Notre Dame Univ., IN (USA)). 1984. Contract AC02-76ER00038. 44p. (NDRL—2552; CONF-840389—5). NTIS, PC A03; 3; GPO Dep. Order Number DE84008505.

From US-Japan information exchange seminar on photochemical energy solar conversion; Okazaki, Japan (12 Mar 1984).

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We study in this paper the dynamics induced by models for photochemical water cleavage systems, focusing on the spatial and temporal factors influencing electron transfer and charge separation processes in such systems. The reaction-diffusion theory is formulated in full generality and the consequences explored in a number of spatio-temporal regimes, viz. the spatially homogeneous system in the long-time limit (i.e. the steady state for a well-stirred system), the spatially homogeneous system in evolution, and the spatially inhomogeneous system in evolution (where, in the latter study, we consider electron transfer at the cluster surface to be governed by a rate constant that reflects the localized nature of such processes). The results of numerical simulations are presented for all three cases and used to highlight the importance of heterogeneous environments in enhancing the cage escape yield of charge separated species, and to demonstrate the dependence of the hydrogen yield on the localization of electron-transfer processes in the vicinity of the microcatalyst surface.

24649 **(SERI/CP—231-2075) Photo/biological hydrogen principal investigators review meeting: proceedings of the May 1983 program review.** (Solar Energy Research Inst., Golden, CO (USA)). Nov 1983. Contract AC02-83CH10093. 147p. (CONF-8305137—). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84000083.

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

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Progress reports on research conducted in support of the Photo/Biological/Hydrogen Program are presented. Individual reports are abstracted for inclusion in the Energy Data Base.

24650 **Homogeneous catalysis of the photoreduction of water by visible light. 3. Mediation by polypyridine complexes of ruthenium(II) and cobalt(II).** Krishnan, C.V.; Creutz, C.; Mahajan, D.; Schwarz, H.A.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Israel Journal of Chemistry;* **22**: 98-106(1982).

Irradiation of polypyridineruthenium(II) complexes (RuL_3^{2+}) in aqueous solutions containing ascorbate (HAs^-) and L'(2,2'-bipyridine or other polypyridines) with visible light yields reduced polypyridine $L'H_3$ and H_2. The quantum yield of H_2 is increased greatly when cobalt(II) is also present and is optimal, phi = 0.13, with L = bpy, L' = 4,4'-$(CH_3)_2$bpy (2×10^{-3} M), [Co(II)] =0.01 M, [HAs^-] = 0.7 M at pH 4.5 to 5.5. The quantum yield of $L'H_2$ is $\geq$ 0.01 when L' = bpy at $\geq 10^{-3}$ M, [HAs^-] = 0.7 M at pH $\sim$ 5 but diminishes greatly at pH $\geq$ 6 or when cobalt(II) is present. The photochemical experiments and pulse-radiolysis studies indicate that the quantum yields reflect the relative rates of some twenty elementary reactions. The rate constant for the first, quenching of $*RuL_3^{2+}$ by HAs^- to give RuL_3^+ and ascorbate radical, spans the range 0.2×10^7 M^{-1} s^{-1} (L = 4,4-$(CH_3)_2$bpy) to 1.1×10^9 M^{-1} s^{-1} (L = 5-(Cl)phen). In the absence of Co(II), RuL_3^+ reduces $L'H^+$ and formation of $L'H_2$ (in competition with oxidation of L'H by ascorbate radical) ensues. When Co(II) is present, Co(L')/sub n/$^{2+}$ complexes are reduced by RuL_3^+ to cobalt(I) complexes Co(L')/sub n/$^+$. These may react with H^+ to form cobalt hydride complexes which undergo further reaction with H_2O, H^+ or $Co(L')_2H^{2+}$ to produce H_2. At high pH, however, these reactions are too slow to compete with oxidation of cobalt(I) ($k \sim 10^{10}$ M^{-1} s^{-1}) and the hydride complexes by ascorbate radical. By contrast, at pH < 4 the H_2 yield drops because of oxidation of $Co^1(L')$/sub n/$^+$ (or its hydride) by $L'H^+$. 4 figures, 7 tables.

0802 Storage

REFER ALSO TO CITATION(S) 24641

0803 Transport

REFER ALSO TO CITATION(S) 24641

24651 (CONF-830974—, pp 137-140) **Hydrogen embrittlement of steel pipelines.** Holbrook, J.H.; Cialone, H.J.; Scott, P.M. (Battelle, Columbus Labs., OH). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Research aimed at identifying the severity of gaseous-hydrogen embrittlement of conventional pipeline steels is discussed. Particular attention is paid to the effect of hydrogen in fatigue-crack

growth since that degradation phenomenon is probably the most serious issue to be addressed before safe transmission of hydrogen in pipelines can become a reality. Brief mention is also made of crack growth under sustained load and of the influence of selected gas additions that could inhibit hydrogen embrittlement.

24652 (CONF-830974—, pp 141-142) **Inhibition of hydrogen degradation in pipeline steels.** Bandyopadhyay, N.; Sieradzki, K. (Brookhaven National Lab., Upton, NY). Sep 1983. NTIS, PC A13/MF A01. Contract AC02-76CH00016.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The nature of the low cycle fatigue problem which piepline steels are likely to suffer from in hydrogen environments under service conditions is discussed. It is argued that the best way of alleviating this problem is with the use of inhibitors. New test data is presented which supports these arguments. The following potential inhibitors have been identified: sulfur dioxide; oxygen; carbon monoxide; and ethylene.

0808 Properties

REFER ALSO TO CITATION(S) 25017

24653 (BNL—51714, pp 224-226) **Theoretical studies of catalysis.** Koszykowski, M.L.; Thiel, P.A.; Melius, C.F.; Binkley, J.S. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24654 **Hydrogen oxidation kinetics in gaseous detonations.** Westbrook, C.K. (Lawrence Livermore National Lab., CA). *Combustion Science and Technology;* **29**: 67-81(1982). Contract W-7405-ENG-48.

A theoretical model including a detailed chemical kinetic reaction mechanism for hydrogen oxidation is used to examine detonation properties for mixtures of hydrogen/air, hydrogen/oxygen, and hydrogen/oxygen diluted with varying amounts of nitrogen. Computed induction lengths are compared with available experimental data for critical energy and critical tube diameter for initiation of spherical detonation, as well as detonation limits in planar and spherical configurations. The ratio of transverse wave spacing to induction length is also computed and contrasted with quantities determined previously for hydrocarbon fuels. 6 figures, 1 table.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 24610, 24611, 24973

24655 (BNL—51714, pp 90-93) **Two-dimensional imaging of flame temperature using laser induced fluorescence.** Cattolica, R.J.; Stephenson, D.A. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Using laser induced fluorescence (LIF) of the OH molecule and image intensified array detectors Alden, et al. [Alden, M., Edner, H., Holmsted, G., Svanberg, S., and Hoegberg, T., App. Opt. 21, 1236-1240, (1982)], Dyer and Crosley [Dyer, M.J. and Crosley, D.R., Opt. Lett. 7,382-384,(1982)], and Kychakoff, et al., [Kychakoff, G., Howe, R.D., Hanson, R.K., and McDaniel, J.C., App. Opt. 21,3225-3227, (1982)] have produced two-dimensional images of the OH fluorescence signal in flames. In order to extract quantitative estimates of OH concentration from these images, the temperature at each point also must be determined. In this presentation the investigators demonstrate the feasibility of using the ratio of two distinct fluorescence images to determie the temperature in the post flame gas of a premixed methane-air flame. The measurement of flame temperature using laser induced fluorescence is based on a two-line excitation technique which yields vibrational level population ratios in the OH molecule. The principal advantages of this two-line excitation method are that it eliminates problems encountered with quenching, fluorescence trappig, nonequilibrium excited state populations, and sensitivity to the spectral bandwidth of the detection system. 5 references, 6 figures.

24656 (BNL—51714, pp 109-112) **CARS meaurements in a premixed methane/air flame using two-channel in situ normalization.** Farrow, R.L.; Lucht, R.P. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Measurements of flame species concentrations using coherent anti-stokes Raman spectroscopy (CARS) require some form of signal intensity calibration, usually by externally generated CARS signals. In situ referencing, a technique which uses for normalization the CARS signal generated by the nonresonant susceptibility of the sample itself, has been shown to be useful for combustion studies. Presently, this technique has been implemented in a unique two-channel detection scheme and is being evaluated in a methane/air flame study. 2 references, 2 figures.

24657 **Industrial co-generation through use of a medium BTU gas from biomass produced in a high throughput reactor.** Feldmann, H.F.; Ball, D.A.; Paisley, M.A. *American Society of Mechanical Engineers, [Paper];* **83-PET-7**: 6(1983).

A high-throughput gasification system has been developed for the steam gasification of woody biomass to produce a fuel gas with a heating value of 475 to 500 Btu/SCF without using oxygen. Recent developments have focused on the use of bark and sawdust as feedstocks in addition to wood chips and the testing of a new reactor concept, the so-called controlled turbulent zone (CTZ) reactor to increase gas production per unit of wood fed. Operating data from the original gasification system and the CTZ system are used to examine the preliminary economics of biomass gasification/gas turbine cogeneration systems. In addition, a "generic" pressurized oxygen-blown gasification system is evaluated. The economics of these gasification systems are compared with a conventional wood boiler/steam turbine cogeneration system.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 24664

24658 (BNL—51714, pp 130-133) **Comprehensive mechanisms for the combustion chemistry of alcohols.** Dryer, F.L. (Princeton Univ., NJ). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

With the exception of methanol, alcohols have received little attention wtih regard to actual combustion chemistry. The current work addresses the development of a comprehensive detailed kinetic model for the pyrolysis and oxidation of ethanol. Intermediate temperature turbulent flow reactor experiments provide initial insights as to the phenomenology of these reactions as well as data to compare the proposed detailed kinetic model at temperatures near 1000 K. Sensitivity analysis used in developing the comprehensive kinetic model. 17 references, 2 figures.

24659 **Determination of soluble and insoluble glucose oligomers with chromotropic acid.** Holtzapple, M.T.; Humphrey, A.E. (Lehigh Univ., Bethlehem, PA). *Analytical Chemistry;* **55**: 548-585(1983). Contract AC02-76ET20025.

A modified Klein-Weissman chromotropic acid assay technique is described for the determination of soluble and insoluble glucose oligomers. A procedure is presented for applying the method to the enzymatic hydrolysis products of cellulose, and the interference of lignin and a method for the elimination of this interference are discussed.

24660 **Update on the 5 t/d cellulose-to-ethanol plant.** Emert, G.H.; Katzen, R.; Fredrickson, R.E.; Kaupisch, K.F.; Yeats, C.E. (Univ. of Arkansas, Fayetteville). *Journal of Applied Polymer Science: Applied Polymer Symposium;* **37**: 787-795(1983). (CONF-8205234—Vol.2).

From 9. cellulose conference; Syracuse, NY, USA (24 May 1982).

Bench-level research and operation of a 1 t/d cellulose-to-ethanol pilot plant has allowed preparation of a detailed process engineering design study for a 50 t/d cellulose-to-ethanol plant. The feedstock proposed for this motor fuel-grade (MFG) alcohol facility would be 37.5 ODt/d of municipal solid waste (light fraction) and 12.5 ODt/d pulp mill waste. The facility would produce 2360 gal/day of 199° proof MFG alcohol. This assumes an overall cellulose-to-ethanol conversion of 45.8% of theoretical, or 51% conversion during simultaneous saccharification-fermentation. The overall conversion expected is 72.8% of theoretical, or 81% conversion during SSF, in which case the demonstration facility can produce 3750 gal/day MFG alcohol. The battery limit investment necessary for the demonstration plant is expected to be $22,560,000. This estimate is based on a six-acre site adjacent to a parent facility that can supply steam, water, power, and facilties for disposal of liquid and solid waste. Accordingly, the estimate does not include any investment for utilities or waste disposal but does provide the tie-ins and general service facilities within the battery limit. 7 references, 1 figure, 6 tables.

0903 Inorganic Hydrogen Compound Fuels

24661 **Kinetics of the reactions of NH_2 radicals with O_3 and O_2.** Patrick, R.; Golden, D.M. (SRI International, Menlo Park, CA). *Journal of Physical Chemistry;* **88**: No. 3, 491-495(2 Feb 1984). Contract AC03-78EV10121.

NH_2 radicals were generated by the photolysis of O_2 in the presence of NH_3 and their subsequent kinetics were directly monitored by laser resonance absorption spectroscopy. Under experimental conditions, $NH_2 + O_3$ and $NH_2 + NH_2$ were competitive reactions. The rate constant for $NH_2 + O_3$ was found to be (1.57 +/- 0.51) x 10^{-11} exp(-(1151 +/- 123)/T) cm^3 $molecule^{-1}$ s^{-1} in the temperature range 272-348 K while the rate constant for $NH_2 + NH_2$ was found to be 1.29 +/- 0.30) x 10^{-11} cm^3 $molecule^{-1}s^{-1}$ at 298 K and essentially independent of temperature at a pressure of ~200 torr. O_2 was added to the system in an attempt to observe a postulated third-order reaction leading to the formation of NH_2OO. An upper limit of 1.5 x 10^{-36} cm^6 $molecule^{-2}s^{-1}$ was set for this process indicating that bonding between NH_2 and O_2 is negligible.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 24866

2466 (DOE/R7/01246—T1) **Appropriate technology program: wood residue for energy. Final report.** (Missouri Forest Products Association, Jefferson City (USA)). 30 Dec 1982. Contract FG47-81R701246. 18p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010458.

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We began the project by reviewing the major users and potential users of wood residue for energy. We then reviewed the inventory and sources of supply and began the process of matching the supply up with the potential users. Considerable effort was expended in developing the sources of supply for handling and loading the material and the transportation net work required to assure timely delivery of the material. One of the objectives of the project was to develop a complete and viable delivery system that would assure long range supply at relatively stable prices. This was accomplished by the Missouri Forest Products Association expanding and developing an existing for-profit corporation set up for this purpose. Considerable effort was expended in organizing this entity as a permanent institution. A plan for informing the appropriate people of our work and resources was carried out by being ever available for meetings, phone calls and correspondence. We developed into a center of information about the potential of wood residue as an alternate fuel in specific locations around the State of Missouri. The files developed as a result of this paper of the work are used almost daily to answer related questions. At this writing, there are installations in Missouri which will consume approximately 50,000 tons of wood residue in a year's time. This is short of the goal we set of 214,580 tons. There are, however, projects in the planning or construction phase that will easily consume that quantity of material. Missouri Forest Products Marketing, Inc., which this grant assisted during the past year, will play a strong role in getting this material utilized. The Environmental Engineer established guidelines for potential users to determine the environmental impact of using wood for energy. This assisted in establishing the trade-offs connected with the overall impact of using wood versus other fuels

13 Hydro Energy

REFER ALSO TO CITATION(S) 24804

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 24804, 24810, 24811, 24812

1403 Economics

24663 **(DOE/RG/06405—T2) Case studies on impacts of rate design on dispersed solar energy systems. Task IIIA. Solar auxiliary electric rate design regulatory analysis.** (ICF, Inc., Washington, DC (USA)). Dec 1979. Contract AC01-78RG06405. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84009514.

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A case study analysis was undertaken of the design of electric rates for residential customers requiring auxiliary electric service for dispersed solar space and water heating systems. The project consists of four principal tasks: (I) review of the literature addressing this issue; (II) selection of five case study utility systems; (IIIA) analysis of regulatory activity on solar rate design and implementation; and (IIIB) analysis of the impacts of alternative rate structures on the cost-effectiveness of solar systems to utility customers and analysis of the impacts which the demands for auxiliary service may have on the costs, revenues, and operating characteristics of the case study utilities. This report presents the analysis and findings relating to Task IIIA: analysis of regulatory activity on solar rate design and implementation. Chapter I defines the scope and purpose of the analysis, summarizes general findings, and provides an overview discussion of the issues. Chapters II to VI present analyses and findings for each of the case studies.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 24663

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 24649, 24650, 24657, 24660, 24662, 24866, 24966, 24972, 24988

24664 **(DOE/CE—0032/1) Biomass energy technology research program summary, FY 1983.** (Solar Energy Research Inst., Golden, CO (USA)). 1983. 271p. NTIS, PC A12/MF A01; GPO Dep. Order Number DE84010754.

Program summaries are presented for ongoing research sponsored by the Division of Biomass Energy Technology during fiscal year 1983. Projects are arranged in the following categories: feedstock production; feedstock conversion; and analysis and crosscutting. Specific technical objectives are to: increase biomass feedstock productivity by factors of 2 to 5 over current yields through species screening, genetic improvements, and innovative agronomic practices; establish the technical feasibility of aquatic species and biological hydrogen as economical sources of biomass feedstocks. Verify the research on advanced concepts using integrated process experiments for producing medium-Btu gas; and verify the research on advanced integrated process experiments for producing liquid

fuels that would substitute for petroleum- and natural gas-derived liquid fuels.

24665 **(DOE/ER/13026—2) Low cost, sprayed $CuInSe_2$ solar cell research. Semiannual progress report, September 15, 1983-March 15, 1984.** Moy, L.; Squillante, M.; Entine, G. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). 1984. Contract AC02-82ER13026. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010480.

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This program on $CuInSe_2$ is investigating a powerful new spray pyrolysis technique as a way to produce efficient solar cell devices by a process which will allow for large scale production of solar cells. The first part of the program was devoted to taking advantage of the chemistry of this new process and to using this spray solution to deposit and characterize the film properties of sprayed $CuInSe_2$ films to identify problems and limitations. During the effort we confronted problems which were also observed by other researchers using various deposition methods. The most serious of these, extra phases and interlayer diffusions, have been individually solved. Experimental methods to apply both solutions to the sprayed films should result in significantly improved device performance. The final period is designed to carry out these methods and demonstrate that efficient devices can be fabricated on sprayed films.

24666 **(DOE/ET/20074—T19) Eucalyptus plantations for energy production in Hawaii 9061. Technical status report, September 30, 1978-March 31, 1984.** (BioEnergy Development Corp., Hilo, HI (USA)). Mar 1984. Contract FC03-78ET20074. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008200.

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The objectives of this project are to investigate a number of options in accomplishing the following: (1) increase the biomass production of Eucalyptus; (2) determine the optimum cultural requirements to maximize yield; (3) assess planting, cultivation, harvesting and transportation equipment requirements, modifying existing equipment if necessary; (4) determine the optimum mixture of biomass (eucalyptus and bagasse) at the generator for the production of electricity; and (5) evaluate a complete production/conversion system which utilized optimum management conditions in relationship to costs.

24667 **(EGG-M—25483) DOE supported research in alcohol fuel technology development.** Dodds, J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 32p. (CONF-840111—6). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007686.

From 8. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (30 Jan 1984).

The Department of Energy sponsored research in alcohol fuel technology development under the direction of Congress and Public Law 96-126. Twenty-seven research grants of about $50,000 each were funded to develop lower cost methods for alcohol fuel production. This paper discusses the objectives of the program and relates the accomplishments achieved by the research. A discussion of the highlights of several selected projects is included.

24668 **(NP—4900856) Industrial-type sweet potatoes: a renewable energy source for Georgia.** Hall, M.R.; Smittle, D.A. (Georgia Univ., Tifton (USA). Georgia Coastal Plain Experiment Station). Jun 1983. 9p. NTIS, PC A02/MF A01. Order Number DE84900856.

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Screening sweet potato breeding lines and cultivars for high content of fermentables was more easily accomplished when percent dry weight, rather than percent sugar and starch, was used as the measurement criterion. A regression equation was established to estimate the percent fermentables from dry weight determinations. Percent fermentables and biomass yield can then be used to estimate alcohol-production potential. Considerable variations in alcohol-production potential and biomass yield occurred among genotypes. High biomass yield should be combined with high fermentable carbohydrate content to maximize alcohol-production potential. Many of the high starch-containing industrial-type sweet potatoes meet these requirement better than the table types which were developed for human consumption. Industrial-type sweet potatoes may also be better suited than some other crops for biomass farming if alcohol production becomes a part of Georgia agriculture and if sweet potato production costs can be reduced.

24669 **(PNL—5052) Photovoltaic Product Directory and Buyers Guide.** Watts, R.L.; Smith, S.A.; Dirks, J.A.; Mazzucchi, R.P.; Lee, V.E. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010569.

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The directory guide explains photovoltaic systems briefly and shows what products are available off-the-shelf. Information is given to assist in designing a photovoltaic system and on financial incentives. Help is given for determining if photovoltaic products can meet a particular buyer's needs, and information is provided on actual photovoltaic user's experiences. Detailed information is appended on various financial incentives available from state and federal governments, sources of additional information on photovoltaics, sources of various photovoltaic products, and a listing of addresses of photovoltaic products suppliers. (LEW)

24670 **(SAND—84-0081C) Photovoltaic concentrators: present status and future role.** Boes, E.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 2p. (CONF-840622—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005520.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

24671 **(SERI/SP—281-2235) SERI photovoltaic advanced research and development. An overview.** Cook, G. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1984. Contract AC02-83CH10093. 56p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84004492.

The photovoltaic program at SERI is partitioned into five research tasks: amorphous thin films, polycrystalline thin films, crystalline silicon, high efficiency concepts, and photoelectrochemical cells. The publication discusses the separate segments of SERI's photovoltaic program, presenting recent achievements in the five tasks, the evaluation and measurement of effort, and in the research support areas. (LEW)

24672 **(SERI/STR—211-2203) $CuInSe_2$ solar cell research by sputter deposition. Semiannual report, February 1, 1983-March 31, 1984.** Thornton, J.A.; Cornog, D.G. (TELIC Corp., Santa Monica, CA (USA)). Mar 1984. Contract AC02-83CH10093. 56p. NTIS, PC A04/MF A01. Order Number DE84004485.

This report covers the period from February 1, 1983, through July 30, 1983. The primary activity during this period has been in the design and fabrication of a research size in-line sputtering apparatus. The apparatus contains four deposition stations, one configured for depositing a metal base electrode, one for depositing $CuInSe_2$ by reactive co-deposition from Cu and In sources, and two for depositing a CdS layer consisting, for example, of (CdZn)S and In doped CdS sub-layers. The apparatus is capable of coating four 25 mm x 25 mm substrates at one time. The $CuInSe_2$ deposition station is isolated from the base electrode metallization and CdS deposition stations by gate valves to minimize cross contamination. The sputtering sources in the $CuInSe_2$ co-deposition station are positioned to significantly reduce composition gradients that were encountered in coatings deposited with the radial apparatus used in our previous work. Measurements of the composition variations across $CuInSe_2$ coatings deposited in our previous work using the radial device have recently been made at SERI by X-ray fluorescence, using a wavelength dispersive spectrometer. The results of these measurements, which appear to correlate with the properties of cells fabricated on similar substrates, are reported. Measurements of cathode conditioning times and effective sputtering yields for operating Cu and In sources in an $Ar+H_2Se$ working gas have been reported previously. Additional data describing the clean-up of pre-

viously conditioned targets during sputtering in pure Ar are reported here.

24673 **(SERI/STR—211-2279) Spray pyrolysis of cadmium sulfide/copper indium selenide cells. Final report, 1 June 1982-30 November 1983.** Mooney, J.B.; Lamoreaux, R.H.; Bates, C.W. Jr. (SRI International, Menlo Park, CA (USA); Stanford Univ., CA (USA)). Mar 1984. Contract AC02-83CH10093. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84004491.

This report describes work done on developing a low-cost method for producing a promising $CuInSe_2/CdS$ solar cell. Previous programs resulted in a cell with 2.5% efficiency. The chemistry of the spray solutions were subsequently studied, as well as the conditions of deposition, to improve the quality of the $CuInSe_2$ layers. The major modification was replacing CuCl for the copper source with $CuCl_3$. The chalcopyrite form of $CuInSe_2$ was deposited in the films over a range of composition variables. The problems of crystal phase and second phases were also addressed. After a series of experiments, it became clear that the chemical nature of the substrate and its temperature were the controlling factors. Consequently, the glass/Mo/$CuInSe_2$/CdS/In structure was emphasized. Solar cells made by vacuum evaporation on these material layers were subject to low shunt resistances, believed to be the result of pinhole shorts. Preliminary experiments using metal etches to remove the molybdenum have eliminated the shorting paths. Future efforts should be directed toward eliminating the pinhole problem; otherwise, the spray pyrolyzed $CuInSe_2$ appears to have the required structural, electrical, and optical properties.

24674 **Formation of aromatic and possible oligomeric materials from cellulose liquefaction.** Russell, J.A.; Hanson, K.R.; Landsman, S.D.; Molton, P.M.; Nelson, D.A. (Pacific Northwest Laboratory, Richland, WA). pp 1199-1224 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—). Contract AC06-76RL01830.

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

The study of the formation of cellulose liquefaction oils may aid the development of a renewable liquid fuel from biomass. Aqueous, alkaline liquefaction of cellulose is a complex process which produces an oil containing high proportions of oxygenated and aromatic compounds. These product compounds result from the recombination of cellulose fragments; mechanisms implicated by earlier work included aldol and Michael reactions. The mechanism of formation of 2,5-dimethylhydroquinone and 2,5-dimethylbenzoquinone is discussed. Dimethylbenzoquinone is formed from the condensation of 3-hydroxy-2-butanone, and is involved in a reduction-oxidation reaction to form dimethylhydroquinone. Reactions occurring after the cellulose liquefaction oil has been formed include possible oligomerization by auto-oxidation or other radical reactions. The cellulose oils show rapid viscosity increases not associated with water or solvent loss; differential scanning calorimetry is consistent with non-linear, branched oligomer formation. The reactions causing these changes are likely to be as complex as those occurring during the formation of cellulose oils.

24675 **Future directions of the Department of Energy's biomass energy research.** Gutstein, M.; Murphy, W.A. (DOE Biomass Energy Technology Division). pp 1409-1416 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—).

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

DOE's Biomass Energy Technology Division (BET) will shortly complete the transition from near-term activities to long-term research. The current goal of the program is to provide the research base from which industry can develop the potential of biomass production and conversion technologies. Technology development, demonstration, and commercialization are areas where the private sector is best suited to assume responsibility. Significant progress has been made in feedstock production technologies (aquatic species, short rotation woody crops) and conversion technologies (thermochemical conversion, anaerobic digestion, biological hydrogen production). However, additional research is necessary before these technologies will fulfill their potential. The Fiscal Year 1983 Biomass Energy Technology Division program stresses basic research on a number of production and conversion technologies.

24676 **Microprocessor controlled heat treatment procedures and simultaneous J-V measurement on CdS/Cu/sub x/S solar cells.** Annamalai, N.K.; Schilling, R.J.; Meyers, S.; Batista, J. (Clarkson Coll. of Tech., Potsdam, NY). pp 891-895 of Modeling and simulation. Vol. 13, Part 2. Computers and computer modeling. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1982). (CONF-820463—Vol.2).

From 13. annual conference on modeling and simulation; Pittsburgh, PA, USA (22 Apr 1982).

Heat treatment procedures were found to be a necessary step to form a diode and improve the output of the solar cell. To understand the heat treatment effects, a microcomputer was employed to take the J-V characteristics of the cells under illumination and to control the heat treatment. The heat treatment procedure in hydrogen was adopted for each cell to optimize the output.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 24669

24677 (DOE/CE/40596—T1, pp 245-247) **Very deep photovoltaic-powered water well.** Davis, R.E. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340. Contract AC08-76NV00020.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The activities associated with the design of a 13,000-watt photovoltaic system by an engineering firm not normally involved with photovoltaic equipment are covered. The procurement and field modification of off-the-shelf modules is discussed.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 24777

24678 **(DOE/JPL—1060-65) Second-law efficiency of solar-thermal cavity receivers.** Moynihan, P.I. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Oct 1983. Contract AM04-80AL13137. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84008508.

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Properly quantified performance of a solar-thermal cavity receiver must not only account for the energy gains and losses as dictated by the First Law of thermodynamics, but it must also account for the quality of that energy. However, energy quality can only be determined from the Second Law. In this paper an equation for the Second-Law efficiency of a cavity receiver is derived from the definition of available energy or availability (occassionally called exergy), which is a thermodynamic property that measures the maximum amount of work obtainable when a system is allowed to come into unrestrained equilibrium with the surrounding environment. The fundamental concepts of the entropy and availability of radiation are explored from which a convenient relationship among the reflected cone half angle, the insolation, and the concentrator geometric characteristics is developed as part of the derivation of the Second-Law efficiency. A comparison is made between First- and Second-Law efficiencies around an example of data collected from two receivers that were designed for different purposes. The author attempts to demonstrate that a Second-Law approach to quantifying the performance of a solar-thermal cavity receiver lends greater insight into the total performance than does the conventional First-Law method.

24679 (SERI/TP—252-1968) Direct-contact preheater/boilers for solar pond power plants. Wright, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1983. Contract AC02-83CH10093. 9p. (CONF-840402—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84000098.

From 6. annual ASME Solar Energy Division technical conference; Las Vegas, NV, USA (10 Apr 1984).

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Heat from a solar pond may be used to drive an organic Rankine cycle and produce electricity. Using a direct-contact preheater/boiler in place of a conventional shell-and-tube boiler may reduce the projected plant cost by 25%. Methods of designing direct-contact preheater/boilers are critically reviewed, and potential designs are discussed.

24680 (SERI/TP—252-2030) Requirements for high-temperature air-cooled central receivers. Wright, J.D.; Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1983. Contract AC02-83CH10093. 5p. (CONF-840402—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84000081.

From 6. annual ASME Solar Energy Division technical conference; Las Vegas, NV, USA (10 Apr 1984).

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The design of solar thermal central receivers will be shaped by the end user's need for energy. This paper identifies the requirements for receivers supplying heat for industrial processes or electric power generation in the temperature range 540 to 1000°C and evaluates the effects of the requirements on air-cooled central receivers. Potential IPH applications are identified as large baseload users that are located some distance from the receiver. In the electric power application, the receiver must supply heat to a pressurized gas power cycle. The difficulty in providing cost-effective thermal transport and thermal storage for air-cooled receivers is a critical problem.

24681 (SERI/TR—211-1950) Theoretical analysis of solar-driven natural convection energy conversion systems. Jacobs, E.W.; Lasier, D.D. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1984. Contract AC02-83CH10093. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84004431.

This report presents a theoretical study of solar-powered natural convection tower (chimney) performance. Both heated and cooled towers are analyzed; the latter uses evaporating water as the cooling mechanism. The results, which are applicable to any open-cycle configuration, show that the ideal conversion efficiencies of both heated and cooled natural convection towers are linear functions of height. The performance of a heated tower in an adiabatic atmosphere ideally approaches the Carnot efficiency limit of ≃ 3.4%/km (1.0%/1000 ft). Including water pumping requirements, the ideal limit to cooled tower performance is ≃ 2.75%/km (0.85%/1000 ft). Ambient atmospheric conditions such as vertical temperature gradient (lapse rate) and relative humidity can have significantly adverse effects on natural convection tower performance. The combined effects of lapse rate and ambient relative humidity are especially important to cooled natural convection towers.

1408 Ocean Energy Systems

24682 (DOE/CE/30716—T17) Closed cycle Ocean Thermal Energy Conversion (OTEC) power plant, Phase II - preliminary design. Project status report and technical progress report, month ending 29 February 1984. (Ocean Thermal Corp., New York (USA)). 29 Mar 1984. Contract AC01-82CE30716. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009301.

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Significant events and accomplishments are reported under the following headings: general management; design management; systems engineering; environmental tasks; land based containment system; pipe systems; and power and energy transfer systems. Planned next month activities are reported under the same headings.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 24680, 24697, 24703, 24704

24683 (CONF-830974—, pp 271-277) Testing of zeolite augmented ice storage and utilization. Redman, C.M. (New Mexico State Univ., Las Cruces). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Under contract from the Battelle Pacific Northwest Laboratories, the New Mexico Solar Energy Institute is developing and testing a zeolite chill augmentation test facility. This facility uses zeolite in a heat pumping mode to augment the cooling stored in ice. Solar energy is used to dry the zeolite to preapre the material for heat pumping. The zeolite chill augmentation system has been constructed, and testing has been initiated. However, at this time, data is insufficient for system performance analysis. The primary advantages of the zeolite chill augmentation facility are: (1) there is an 8.4 reduction in seasonal storage size allowed by the sublimation instead of the melting of ice; (2) if the stored ice is used up, the system will still furnish 32°F cooling at 88% of cooling with storage; and (3) the cost of a production model can be charged to winter solar heating and desalination of brackish water.

24684 (CONF-830974—, pp 283-289) Solar district heating system using seasonal storage for the Charlestown, Boston Navy Yard National Historical Park. Breger, D.S.; Michaels, A.I. (Argonne National Lab., IL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This project has conducted an analysis of a seasonal storage, solar, district heating system utilizing two existing underground, concrete tanks in the National Historic Park of the Charlestown Navy Yard in Boston. The analysis was performed with MINSUN Version III, a computer simulation program written particularly for solar seasonal storage systems. Input parameters were derived in preliminary studies and reviewed and updated for this later study. Three collector types were studied with and without a heat pump. Results indicate a definite performance and economic improvement for all collector types by including the heat pump. Flat plate collectors showed substantially greater improvement due to their more pronounced increase in efficiency at the lower inlet temperatures. With the heat pump, all three collectors provide comparable performance, and the flat plates were chosen as the design system due to their lower cost.

24685 (DOE/CE/40596—T1, pp 399-403) Project management of a major solar retrofit project. Benator, B.I.; Wright, R.H.; Briscoe, H.H.; Stubblefield, N.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

In Spring 1982, Floyd Medical Center, a regional hospital serving Nothwest Georgia and Northeast Alabama, put on line a solar domestic hot water (DHW) system. The DHW retrofit project, taking 2-1/2 years from energy audit to final inspection, was implemented in several distinct phases. It was designed to produce a practical energy savings project and not to be a solar research and development project. In the same light, the purpose of this paper is not to add to the copious technical literature currently available; rather, it is to discuss the real-world project management of a major solar retrofit project. It will discuss the actual techniques used, lessons learned, and provide guidance which may be useful to others in project management of similar projects. Some background information is given.

24686 **(DOE/CS/30524—T1) Thermal gain shutter control. Preliminary design phase. Final report.** Kuzdrall, J.A. (Intrel Service Co., Nashua, NH (USA)). 1 Oct 1983. Contract FC02-80CS30524. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84008050.

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The Thermal Gain Sensor is an insulation control system for manual and motorized solar shutters. Unlike ordinary systems, control is based on the actual net thermal flow through the window, rather than a tenuous or indirect measure. The sensor continuously and directly tracks the conduction, convection, and radiation losses as well as the attenuated solar input. The hardware consists of a sensor, a control box, and an optional power controller for motorized shutters. The purpose of the preliminary design phase, the first of a four phase product development program, is to assure that there are no technical, cost, or acceptance barriers to the potential product. Accordingly, the first objective of this phase was to determine if, with properly selected materials and dimensions, a practical sensor could accurately determine the real thermal gain threshold under the wide range of installations, geographic locations, and weather conditions. The second objective, having found the best possible sensor design, was to determine whether the level of performance attainable produced significantly more energy savings than competitive control systems, namely time and sunlight activated systems. Another objective of this phase was to assure that the product could be made for an acceptable cost. To this end, a schematic design, including conceptual drawings, was prepared. From this conceptual design, manufacturing cost estimates were made using industry accepted estimating procedures. Finally, it was required to determine whether there was public interest in the product. For this, a preliminary assessment of the market was made, based on unsolicited inquiries and local discussions.

24687 **(DOE/CS/30569—29) Open cycle lithium chloride cooling system. Final report, March 1, 1982-May 28, 1983.** Lenz, T.G.; Loef, G.O.G.; Iyer, R.; Wenger, J. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). May 1983. Contract AC03-81CS30569. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84005831.

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A lithium chloride open cycle absorption chiller has been designed, built and tested. Solution reconcentration takes place in a small counter-current packed column supplied with solar heated air. Removal of non-condensable gases that enter the chiller dissolved in the strong solution and the make-up refrigerant streams is accomplished by a liquid-jet ejector and a small vacuum pump. Cooling capacities approaching 1.4 tons and COP levels of 0.58 have been achieved at non-optimum operating conditions. Test results from preliminary system operation suggest that mass transfer processes in both the packed column reconcentrator and the absorber are controlled by concentration gradients in the lithium chloride solution. Liquid phase controlled mass transfer dictates an operating strategy different from the previously assumed gas phase controlled process to obtain maximum rates of evaporation in the packed column. Determination of optimal operating conditions leading to decreased electrical power consumption and improved cooling capacity and coefficient of performance will require further analysis and testing.

24688 **(DOE/R7/01002—T1) Environmental Quadraplex. Final report.** (Andra Partners, Cedar Rapids, IA (USA)). 14 Jan 1981. Contract FG47-79R701002. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007810.

A brief report is given on the research and development of an architectural design for a solar community that will utilize applications of active and passive solar systems specifically for retired persons in multi family dwelling. The design selected was a four-condominium unit.

24689 **(DOE/R7/01018—T1) Solar addition for the University for Man Appropriate Technology Program.** (University for Man, Manhattan, KS (USA)). 1979. Contract FG47-79R701018. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007755.

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In 1978, UFM joined with the College of Architecture and Design at Kansas State University (KSU) to create an Appropriate Technology Program (ATP) aimed at promoting local self-reliance in the areas of energy, food, shelter, and waste management. Central to the role and mission of the ATP is the passive solar addition, a multi-purpose facility designed to provide a highly visible, publicly accessible demonstration of low-cost, effective ways to use renewable energy sources for space heating and cooling, food production, water heating, waste recycling, and other typically energy intensive processes. Designed through an intensive, participatory workshop process involving several agencies representing the needs of special populations, the building was completed in November 1980. It contains a community solar greenhouse, a lounge, kitchenette and appropriate technology resource library, and a community workshop. It is estimated that 80% of the building's seasonal space heating needs are supplied by the sun. A wood stove and a gas-fired hydronic (hot water) back-up system provide heat during extended cloudy periods. The high solar fraction is achieved through the use of heavy resistance thermal insulation (R-20 walls, R-40 ceiling), extensive south-facing glazing (714 sq. ft. of Kalwall), movable insulation (Beadwall, hinged shutters, insulating roller shades), and interior thermal mass (4 inch limestone walls, grout-filled concrete block walls, concrete slab and tile floors, deep earth planting beds.

24690 **(DOE/R7/01046—T1) Solar energy feasibility study for the Chadron Middle School Building, Chadron City Schools, Chadron, Nebraska.** (Dunham Associates, Inc., Rapid City, SD (USA)). 5 Jun 1980. Contract FG47-79R701046. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84007730.

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The technical and economic feasibility of utilizing solar energy for heating of domestic hot water and building heating for the Chadron Middle School in Chadron, Nebraska was investigated. The study was conducted in four principle interactive phases: (1) data collection; (2) identification of potential uses for solar energy; (3) system modeling; and (4) analysis. The results of this study are presented.

24691 **(DOE/R7/01158—T1) Convertible solar porch for space heating and greenhouse use. Final technical report.** Wiens, P. (Wiens (Pamela), Kansas City, KS (USA)). 1984. Contract FG47-80R701158. 24p. NTIS, PC A02 ; 3; GPO Dep. Order Number DE84007844.

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This project demonstrates a method of enclosing an existing south-facing porch with removable glass panels for greenhouse use and supplemental heating. The porch was divided into two sections: a greenhouse area and a vestibule or double-entry area. The removable glass panels enclosing both areas are made of wooden frames and double-strength glass. Double glazing is provided with continuous plastic sheeting on the inside. The greenhouse is well-insulated, water barrels are used for heat storage, and all edges are caulked or weatherstripped. A fan forces excess heat from the greenhouse into the house and both the greenhouse and the vestibule have panels, which open for ventilation.

24692 **(DOE/R7/01229—T2) Measured cooling performance of earth contact cooling tubes.** Chen, B.; Wang, T.C.; Maloney, J.; Ennenga, J.; Newman, M. (Nebraska Univ., Omaha (USA)). 1981. Contract FG47-81R701229. 7p. NTIS, PC A02; 3; GPO Dep. Order Number DE84009769.

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Earth contact cooling has become a well known technique for the cooling of buildings. One variant of the technique involves the direct burial of a pipe at some depth in the ground. By drawing warm air through the tube, heat is absorbed through the walls of the cooling tube by the earth surrounding the tube and, thus, cooled air is drawn into the building. The preliminary results of the cooling field of the Passive Solar Research Group are presented in this paper. Most models to date attempt to model the performance of a single tube and then to generalize results as parameters such as

diameter or length are altered. These generalizations are usually accomplished without actual data to corroborate model predictions. For the Nebraska experiments, a series of measurements were conducted as the parameters of diameter and length were changed. Three fields of temperature sensors emanate horizontally and vertically from each of the buried pipes. Inlet and outlet temperatures as well as temperatures along the length of the tube were monitored. In addition to tube length, flowrate and tube diameter, it was found that cooling is highly dependent on the temperature difference between ambient and soil temperature. Also, the greatest temperature drops were found to occur at the inlets of each tube.

24693 **(DOE/R7/01229—T3) Measured and predicted cooling performance of earth contact cooling tubes.** Chen, B.; Wang, T.C.; Maloney, J.; Newman, M. (Nebraska Univ., Omaha (USA)). 1983. Contract FG47-81R701229. 6p. NTIS, PC A02; 3; GPO Dep. Order Number DE84009770.

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Earth contact cooling has become a well known strategy for keeping buildings cool. The technique involves the direct burial of some length of pipe in the ground. By drawing warm air through the tube, heat is absorbed through the walls of the cooling tube by the earth surrounding the tube. The experiments took place at the Passive Solar Research Test Facility which is located on the Omaha Campus of the University of Nebraska during the summer of 1982. A series of measurements were conducted as the parameters of depth, diameter and length were changed.

24694 **(ORNL/CSD—127/P1) PCMSOL-1: a computer simulation code for a direct gain passive solar structure. Part I. Theory and basic relations.** Geist, G.A.; Serbin, C.A.; Solomon, A.D.; Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)). Feb 1984. Contract W-7405-ENG-26. 45p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007932.

A simulation program, PCMSOL-1, for a passive solar structure is described. PCMSOL-1 is a finite difference computer simulation of a one room direct gain building that contains phase change materials (PCMs) in panels which may be located on any interior surface. The description of the program is in two parts. The first is devoted to the theory and basic relations used in the code. A complete listing, documentation, and sample output, are given in the second part.

24695 **(UT/CES-SS—4) Operational results for a solar-heated-and-cooled apartment building.** Vliet, G.C. (Texas Univ., Austin (USA). Center for Energy Studies). Jul 1983. 95p. NTIS, PC A05/MF A01. Order Number DE84900196.

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A monitoring study was undertaken of a 12-unit apartment building that previously had been retrofitted to provide solar energy for water heating, space heating, and space cooling. Data were collected for two periods: July-August 1979 (1979 period) and February-August 1980 (1980 period). The collection function was the major contributor to poor overall system performance, since the submarginal collection (low hot-tank temperatures) caused excessive cycling of the space heating and cooling functions. In addition to exhibiting well below expected steady-state efficiencies, the collectors also caused excessive downtime. Collector leakage problems finally caused termination of the project. Good flat-plate collectors would have been a major improvement.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 24670, 24678, 24970

24696 (DOE/CE/40596—T1, pp 393-397) **Shallow solar pond progress.** Burrows, D.L.; Dinse, D.R.; Needham, V.A. III. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Several lost-cost shallow solar pond projects are now under design or are being constructed throughout the nation. Four such systems are presently in design or pending construction for commercial and industrial applications with the Tennessee Valley Authority participation. These applications include: building service hot water for a hospital, process hot water for a photographic laboratory, process hot water for industrial textile dyeing, and TVA's own shallow solar pond performance test modules. Design and construction techniques for these solar applications have produced system ranging for \$10 to \$30/ft^2 and yielding approximately .15 to .20 MM Btu/ft^{2}y. These systems are compared on differences in design, and actual or estimated construction cost. Economics are discussed. Some performance data comparison is presented on projects operational by June, 1982.

24697 **(DOE/R7/01003—T1) Hot air solar collector for domestic water heating. Final report.** DeYarman, K. (DeYarman (Kerry), Cedar Rapids, IA (USA)). 1984. Contract FG47-79R701003. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007812.

The project consists of double-glazed, poured urethane insulation solar collectors. They will be assembled in modules of five feet; four units long for a total length of twenty feet. The heat-medium will be hot air passing over the collector plate and being returned underneath the collector plate making a complete heating cycle; the air will be doubly heated both on top and on the bottom. The heated air will then be pumped into an insulated water storage tank located in my basement where it will heat the water in the storage tank. The water in the storage tank will be used by the household occupants.

24698 **(DOE/R7/01122—T1) Development of low cost concentrating solar collectors. Final report.** Batzer, D. (Batzer (D.)., St. Charles, MO (USA)). 31 Jan 1982. Contract FG47-80R701122. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007715.

A low cost concentrating collector has been developed that has the following features: (1) Material cost per 4 foot by 8 foot panel of \$175 or \$225 at retail prices depending on which of the two versions are used. (2) Low weight of 159 pounds per panel when liquid-filled or approximately 5 pounds per square foot to result in minor additional roof stress. (3) A concentration factor of 1.72 to reduce the necessary storage volume for winter heating and obtain adequate temperature for future air conditioning.(4) High efficiency when mounted parallel to the roof to reduce wind damage, roof stresses, and blend better with architectural features of a house.

24699 **(NBS-TN—1170) Weathering performance of cover materials for flat plate solar collectors.** Clark, E.J.; Roberts, W.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Nov 1982. Contract AI01-76PR06010. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84008387.

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Weathering studies were performed to obtain data on the performance and durability of cover plate materials for flat plate solar collectors used in solar heating and cooling systems. Ten materials were evaluated to assess their durability after natural weathering and artificial weathering with a xenon arc light. The materials were weathered for four years on small mini-collectors in Arizona, Florida, and Maryland after which the solar energy transmittance and the effect of dirt on the transmittance were measured. The tensile properties of selected film materials were also assessed after weathering. The effects of the natural weathering are compared: (1) for materials exposed as inner and outer cover plates for each weathering site; (2) for the three weathering sites; and (3) with materials artificially weathered with a xenon arc light.

24700 **(SERI/TP—253-2079) Technical and cost potential for lightweight, stretched-membrane heliostat technology.** Murphy, L.M. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1984. Contract AC02-83CH10093. 8p. (CONF-840402—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004433.

From 6. annual ASME Solar Energy Division technical conference; Las Vegas, NV, USA (10 Apr 1984).

This paper presents the background and rationale and describes the development effort of a potentially low-cost, concentrat-

ing reflector design. The proposed reflector design is called the stretched-membrane concept. In this concept a reflector film - which can be metal, polymeric, or of a composite construction - is stretched on a hollow torroidal frame that offers a structurally efficient and optically accurate surface. Although the intent is to improve heliostat concentrator cost and performance for solar thermal applications, the collector design approach proposed here may well offer effective cost and performance opportunities for improving photovoltaic and solar daylighting applications as well. Some of the major advantages include a reflector, a support frame, and support structures that can be made extremely lightweight and low in cost because of the effective use of material with high average stress levels in the reflector and support frame; a 75% reduction in the weight of the reflector and support structure (down to the drive attachment) over the second-generation glass-and-metal heliostat concept; a better than 50% cost reduction for the reflector assembly and support structure compared to corresponding elements of the second-generation concept; and, finally, optical accuracies and an annual energy delivery potential close to those attainable with current glass-and-metal heliostats. In this paper results of initial design studies, performance predictions, and analysis are presented, as well as results corresponding to subscale testing. Also included are recommendations for further development and for resolving remaining issues.

24701 **(SERI/TR—255-1505) Performance tests of the Solar Steam, Inc., 9-m deep-dish solar concentrating collector.** Masterson, K.; Gaul, H. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1983. Contract AC02-83CH10093. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84000079.

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Thermal and optical data were collected and compared to determine system efficiency and optical accuracy. Mirror reflectance (0.83), receiver absorptance (0.95), and the transmittance factor due to aperture blockage (0.915) gave a rho tau α product of 0.72. The beam spread due to the reflector surface was measured to be 19 mrad from off-axis thermal performance and 24 mrad by the Reverse Illumination Method, which is described in detail. The beam spread and concentration ratio combine to give an intercept factor of 0.99 for the 58-cm-diameter receiver and total optical efficiency of 0.71. Thermal performance was measured using temperature increases in the output for various water flow rates. The data were fit using a theoretical model for thermal receiver losses. From this curve the optical efficiency was found to be 0.69 and the stagnation or zero flow temperature of the receiver was estimated to be about 470°C. Above 85°C output temperature, better performance was predicted when using a 40-cm-diameter receiver. Construction details of the collector are also given.

24702 **(SERI/TR—8260-1-T1) Evaluation of vacuum deposition-sputter deposited cermet selective absorber coatings. Final report, January 15, 1980-November 30, 1982.** Thornton, J.A.; Lamb, J.L. (TELIC Corp., Santa Monica, CA (USA)). 31 Dec 1982. Contract AC02-77CH00178. 95p. (TELIC—82-4). NTIS, PC A05/MF A01. Order Number DE83014482.

In a preliminary investigation at Cornell University it was shown that Pt/Al_2O_3 cermet coatings with graded Pt composition profiles could be deposited by co-evaporation in forms that yielded excellent selective absorber properties and thermal stability at 600°C in air. The co-evaporation method is difficult to apply to the variety of substrates that are of interest for medium and high temperature solar thermal receivers. Accordingly, this project was undertaken to investigate the use of sputtering. Three coating configurations were examined: (1) cermets with graded Pt compositions and Al_2O_3 antireflection layers; (2) cermets with uniform Pt compositions and Al_2O_3 antireflection layers; and (3) Al_2O_3-M-Al_2O_3 type coatings with Pt/Al_2O_3 M-layers. Sputter co-deposition was used to form the cermet layers. Direct rf sputtering of alumina and dc reactive sputtering of aluminum were investigated as methods for depositing the Al_2O_3. The rf sputtered Al_2O_3 was found to yield coatings with superior thermal stability. Thus, when deposited with re-sputtered Ak_2O_3 onto Pt base layers at elevated temperatures, all three of the coating configurations listed above were stable in air at 600°C. Absorptances were in the range 0.90 to 0.95. The graded cermet coatings appear to be the generally most useful of the three types examined. Optimized coatings on Pt coated glass substrates have yielded absorptances of 0.97 and room temperature emittances of about 0.08. Alternative ir reflector layer materials such as Cr, Mo, Ta, W and ZrB_2 were investigated and concluded to be limited to low temperature (~ 400°C) applications. Substrate surface polishing is concluded to be an important consideration affecting the optical properties and thermal stability of coatings. Experiments are described in which 24 inch long receiver tubes were coated with Pt/Al_2O_3 graded cermet coatings by sputtering.

1420 Heat Storage

REFER ALSO TO CITATION(S) 24691, 24696

24703 (CONF-830974—, pp 15-21) **Heat storage building materials for passive solar applications.** Fletcher, J.W. (Lockheed Missiles & Space Co., Inc., Huntsville, AL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The objective of this study was to develop a heat storage building material to be used for passive solar applications and load leveling within residential/commercial building spaces. Three phase change materials (PCMs) were evaluated for use in double-walled, hollow-channeled plastic panels as replacements for standard wallboard and ceiling panels. Performance tests conducted during this study indicate that the PCM-filled plastic panels can be completely charged/discharged on a daily basis by convective and radiative means. Typical PCM related problems with containment, nucleation, corrosiveness, incongruent melting, super-cooling and cycle lifetime have been addressed, and no significant barriers to future development are anticipated. Computer simulated comparisons of a PCM and conventionally fitted passive solar building indicate a significant improvement in heating requirements and thermal comfort using the PCM ceiling and wall panels. Overheating of the structure was also reduced dramatically during fall and spring months, substantially reducing cooling (ventilation) requirements.

24704 (CONF-830974—, pp 22-28) **Modelig a direct gain solar structure containing PCMs.** Solomon, A.; Serbin, C.; Tomlinson, J. (Union Carbide Corp., Oak Ridge, TN). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The aim of our work is the development of a flexible computer simulation program for heat transfer in a direct gain solar structure containing phase change materials. The code in its present state, its underlying principles, its numerical implementation, some results obtained thus far, and future work are described.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 24804

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 24708

24705 **Hawaii geothermal resource assessment: 1982.** Thomas, D.M.; Cox, M.; Kavahikaua, J.P.; Lienert, B.R.; Mattice, M. (Hawaii Institute of Geophysics). *Transactions - Geothermal Resources Council;* **6**: 63-66(Oct 1982). Contract AS03-79ET27023.

The Geothermal Resource Assessment Program of the Hawaii Institute of Geophysics has conducted a series of geochemical and geophysical surveys throughout the State of Hawaii since February 1978. The results compiled during this study have been used to prepare a map of potential geothermal resource areas throughout the state. Approximately thirteen separate locations on three islands have been studied in detail. Of these, four areas are known to have direct evidence of a geothermal anomaly (Kilauea East Rift Zone, Kilauea Southwest Rift Zone, Kawaihae, and

Olowalu-Ukumehame) and three others are strongly suspected of having at least a low-temperature resource (Hualalai west flank, Haleakala Southwest Rift, and Lualualei Valley). In the remainder of the areas surveyed, the data obtained either were contradictory or gave no evidence of a geothermal resource.

24706 **An analysis of the geothermal potential of Southwestern New Mexico.** Lohse, R.L.; Icerman, L. (New Mexico State University Energy Institute, Las Cruces, New Mexico). *Transactions - Geothermal Resources Council;* 6: 39-42(Oct 1982). Contract AS07-78ID01717.

Data sets for actual temperatures; bottom-hole temperature gradients; geotemperatures; tectonics; lineaments; and complete and residual Bouguer gravity were analyzed in order to assess the geothermal potential of southwestern New Mexico. Major NW-SE and N-S trends of structual weakness and control, suggested by these data, intersect in the general area of Dona Ana County and appear to be crossed by NE-SW trending secondary zones of weakness. Temperature data imply that there is a spatial relationship between intersections of these trends and potential geothermal anomalies, which suggests that the hydrothermal systems are predominately fault controlled.

1502 Geology And Hydrology Of Geothermal Systems

24707 **(DOE/ET/27111—T3) Factors controlling reservoir quality in tertiary sandstones and their significance to geopressured geothermal production.** Loucks, R.G.; Richmann, D.L.; Milliken, K.L. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1981. Contract AC08-79ET27111. 45p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010481.

Report of Investigations No. 111.

Variable intensity of diagenesis is the factor primarily responsible for contrasting regional reservoir quality of Tertiary sandstones from the upper and lower Texas coast. Detailed comparison of Frio sandstone from the Chocolate Bayou/Danbury Dome area, Brazoria County, and Vicksburg sandstones from the McAllen Ranch Field area, Hidalgo County, reveals that extent of diagenetic modification is most strongly influenced by (1) detrital mineralogy and (2) regional geothermal gradients. The regional reservoir quality of Frio sandstones from Brazoria County is far better than that characterizing Vicksburg sandstones from Hidalgo County, especially at depths suitable for geopressured geothermal energy production. However, in predicting reservoir quality on a site-specific basis, locally variable factors such as relative proportions for porosity types, pore geometry as related to permeability, and local depositional environment must also be considered. Even in an area of regionally favorable reservoir quality, such local factors can significantly affect reservoir quality and, hence, the geothermal production potential of a specific sandstone unit.

24708 **(DOE/ID/12044—T3) Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.** Priest, G.R.; Vogt, B.F. (eds.). (Oregon Dept. of Geology and Mineral Industries, Portland (USA)). 1983. Contract FC07-79ID12044. 156p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE84007672.

Separate abstracts were prepared for seven papers. (MHR)

24709 **(DOE/NV/10174—2(MAP)) South Louisiana geopressured tertiary sandstones.** McCulloh, R.P.; Kosters, E.C.; Pino, M.A. (Louisiana State Univ., Baton Rouge (USA)). 1984. Contract AC08-81NV10174. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008923.

1503 Geothermal Exploration And Exploration Technology

24710 **(UCRL—90040) Calibration of a neutron log in partially saturated media IV: effects of sonde-wall gap.** Axelrod, M.C.; Hearst, J.R. (Lawrence Livermore National Lab., CA (USA)). 8 Mar 1984. Contract W-7405-ENG-48. 16p. (CONF-8406110—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008570.

From 25. logging symposium; New Orleans, LA, USA (12 Jun 1984).

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A gap between a neutron sonde and the wall of a borehole can have a significant effect on the observed count rate. This effect was determined experimentally to be linear with gaps as large as 2.5 cm. The count rate is given by N/sub N/ = $K_0 + K_1 g$ where K_0 is the count rate that would be observed at zero gap, and g is the gap. The parameters K_0 and K_1 are dependent on both water (ie. hydrogen) content and bulk density. In many situations failure to correct the count rate for this gap effect can result in a significant degradation in the accuracy of the water content calculated from the count rate. In a dry borehole, K_1 is small at zero formation water content, and increases with formation water content. In a water-filled borehole, K_1 is large at zero formation water content, and tends to decrease with increasing formation water content, becoming zero, as of course it must, if the formation is pure water. The absolute value of K_1 increases with increasing density. A representation was determined for K_0 and K_1 from experimental data. This representation can be used to adjust the count rate at a given gap to equal its zero-gap value. The accuracy of the zero gap equation can then be recovered.

24711 **(USGS-OFR—83-429) Colorado: basic data for thermal springs and wells as recorded in GEOTHERM.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). May 1983. 176p. NTIS, PC A09. Order Number DE84900960.

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GEOTHERM sample file contains 225 records for Colorado. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for Colorado. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by the county name and the name of the source. Also given are latitude, longitude (both use decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix B is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Adjacent one-degree blocks which are published as a 1:250,000 map are combined under the appropriate map name. Also given are GEOTHERM record identifier, and temperature (°C). A bibliography is given in Appendix D.

24712 **Hydrogen and oxygen isotope geochemistry of cold and warm springs from the Tuscarora, Nevada Thermal Area.** Bowman, J.R.; Cole, D. (Dept. of Geology and Geophysics, Univ. of Utah, Salt Lake City, UT). *Transactions - Geothermal Resources Council;* 6: 77-80(Oct 1982). Contract AC07-79ID12079.

Eighteen cold and warm spring water samples from the Tuscarora, Nevada KGRA have been analyzed for hydrogen and oxygen isotope composition and fluid chemistry. Warm springs have δD values (128 to -137 permil) significantly lower than those of cold springs to the north and east of the area, but similar to the δD values of cold springs to the west and south (-131 to -135 permil). The recharge area for the warm springs is unlikely to be to the immediate north, which is the local topographic highland in the area. The hydrogen isotope data would permit recharge from areas to the southwest or from high elevations to the southeast (Independence Mountains), a sector consistent with electrical resistivity evidence of fluid flow. Warm springs are HCO_3^--rich waters, enriched by a factor of 3 to 10 in Na, HCO_3^- and SiO_2 relative to local cold springs. Average quartz (no steam loss) and Na/K/Ca geothermometer estimates suggest subsurface temperatures of 145° and 196°C, respectively. The warm springs exhibit poor correlations between either hydrogen or oxygen isotope composition and water temperature or chemistry. The absence of such correlations suggests that there is no single coherent pattern of cold water mixing or evaporation in the thermal spring system.

24713 **Thermal and tectonic history of the Mineral Mountains intrusive complex.** Evans, S.; Nielson, D.L. (Earth Science Laboratory Division, University of Utah, Research Institute, Salt Lake City, Utah). *Transactions - Geothermal Resources Council;* 6: 15-18(Oct 1982). Contract AC07-79ID12079.

Study of the Mineral Mountains intrusive complex was undertaken to decipher interrelationships of intrusion, uplift rate and structural control as related to the Roosevelt Hot Springs geothermal system. Results of fission track and K-Ar dating show that different units of the intrusive complex underwent similar cooling histories. Uplift rates calculated for the north (0.25 mm/yr) and central (0.5 mm/yr) portions differ substantially. This difference in uplift rate may have accounted for the development of faulting which has been important as structural controls on the geothermal system.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 24708

1506 Environmental Aspects And Waste Disposal

24714 **(ORNL/TM—9071) Retrospective examination of geothermal environmental assessments.** Webb, J.W.; Eddlemon, G.K.; Reed, A.W. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010615.

Since 1976, the Department of Energy (DOE) has supported a variety of programs and projects dealing with the exploration, development, and utilization of geothermal energy. This report presents an overview of the environmental impacts associated with these efforts. Impacts that were predicted in the environmental analyses prepared for the programs and projects are reviewed and summarized, along with measures that were recommended to mitigate these impacts. Also, for those projects that have gone forward, actual impacts and implemented mitigation measures are reported, based on telephone interviews with DOE and project personnel. An accident involving spills of geothermal fluids was the major environmental concern associated with geothermal development. Other important considerations included noise from drilling and production, emissions of H_2S and cooling tower drift, disposal of solid waste (e.g., from H_2S control), and the cumulative effects of geothermal development on land use and ecosystems. Mitigation measures were frequently recommended and implemented in conjunction with noise reduction; drift elimination; reduction of fugitive dust, erosion, and sedimentation; blowout prevention; and retention of wastes and spills. Monitoring to resolve uncertainties was often implemented to detect induced seismicity and subsidence, noise, drift deposition, concentrations of air and water pollutants, and effects on groundwater. The document contains an appendix, based on these findings, which outlines major environmental concerns, mitigation measures, and monitoring requirements associated with geothermal energy. Sources of information on various potential impacts are also listed.

1509 Geothermal Engineering

24715 **(PNL—4651) Development of a high temperature pH electrode for geothermal fluids. Final report, Task III and year end summary.** Niedrach, L.W.; Stoddard, W.H. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Feb 1983. Contract AC06-76RL01830. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010689.

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This report summarizes work done to demonstrate the applicability of a stabilized zirconia pH sensor to high temperature measurements on brines containing as much as 20 weight percent NaCl and 100 ppM hydrogen sulfide. Throughout the program stable operation was achieved, and measured pH values were in good agreement with calculated values. Differences were generally less than 0.5 pH unit at 285°C, and it is not yet certain whether the discrepancies are associated with the measured or calculated values of the pH. While some sensors failed through cracking or because of uperfected seals, no signs of chemical degradation of the ceramic were detected during tests at 285°C covering a range of pH between 3 and 9. Two sensors were operated at 285°C for periods of 11 days, and one was employed in successive tests for a total of 37 days. At the end of this period the sensor was still satisfactory, and it was forwarded to the sponsoring laboratory, PNL, for further tests. Although most of the work was performed at 285°C a limited amount of testing was done at lower temperatures: 95, 150, and 225°C. Sensors prepared from in-house tubes and from tubes obtained from a new supplier performed well at 95°C for extended periods, in spite of earlier difficulties with the standard ceramic at this temperature. There is still, however, some uncertainty concerning the adequacy of our seals particularly in cycling between 285°C and lower temperatures.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 24946

17 Wind Energy

REFER ALSO TO CITATION(S) 24804, 24810, 24811, 24812

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 24681

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 24743, 24866, 24880, 24886, 24887, 24888, 24894, 24894

24716 (DOE/CE/40596—T1, pp 441-448) **Some thermodynamic aspects of desalting through steam boiler plants.** Stecco, S.S.; Galletti, A. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The various possible solutions for sea water desalting are shown. Thermodynamic considerations for desalting and steam power plants with desalting facilities are discussed. (MHR)

24717 **(DOE/ET/29372—3) Effects of voltage control in utility interactive dispersed storage and generation systems.** Kirkham, H.; Das, R. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1983. Contract AI05-79ET29372. 259p. (JPL-PUB—83-61). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84008519.

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When a small generator is connected to the distribution system, the voltage at the point of interconnection is determined largely by the system and not the generator. This report examines the effect on the generator, on the load voltage and on the distribution system of a number of different voltage control strategies in the generator. Synchronous generators with three kinds of exciter control are considered, as well as induction generators and dc/ac inverters, with and without capacitor compensation. The effect of varying input power during operation (which may be experienced by generators based on renewable resources) is explored, as well as the effect of connecting and disconnecting the generator at ten percent of its rated power.

24718 **(EPRI-CS—3158) Symposium proceedings: power plant feed pumps - the state of the art.** Makay, E.; Diaz-Tous, I.A. (Energy Research and Consultants Corp., Morrisville, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA). Fossil Fuel Power Plant Dept.). Jul 1983. 394p. (CONF-8206209—). NTIS, PC A17/MF A01. Order Number DE83902536.

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Separate abstracts were prepared for the papers presented in the following areas: (1) Feed Pump Hydraulic Design; (2) Feed Pump Mechanical Design Components; (3) Feed Pump System Design; (4) Feed Pump Operation, Maintenance, and Diagnostics; and (5) Feed Pump Hydraulic Performance and Design Improvements.

24719 (EPRI-CS—3158, pp 1.1-1.21) **Power plant feed pumps - the state of the art.** Diaz-Tous, I.A. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The paper summarizes the state of the art of power plant feed pump technology discusses pump availability trends, identifies major mechanisms of pump instabilities, identifies areas currently being addressed in design guide development, and notes areas in which advances in state of the art are needed.

24720 (EPRI-CS—3158, pp 1.22-1.24) **Reliability of large boiler feed pumps in the power industry.** Makay, E. (Energy Research & Consultants Corp., Morrisville, PA). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Typical failure causes are identified that are judged as the most frequent causes of boiler feed pump failures resulting in power plant non-availability.

24721 (EPRI-CS—3158, pp 2.1-2.10) **Comments on impeller-volute interactions.** Chamieh, D.S.; Caughey, T.K.; Brennen, C.E.; Acosta, A.J. (California Inst. of Technology, Pasadena). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The impact of impeller-volute mismatch on pump efficiency is discussed. The Rotor Force Test Facility is described which measures the force on the shaft of an impeller when the center of the shaft is moved relative to the volute. Results are reported.

24722 (EPRI-CS—3158, pp 2.11-2.23) **Design of feed pump hydraulic components.** Dernedde, R. (Klein, Schanzlin & Becker, Frankenthal, Germany); Stech, P.R. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Improvement in the useful life of large feedwater pumps between major repair efforts is the goal of efforts aimed at minimizing cavitation. The significance of minimum available net positive suction head in design is discussed.

24723 (EPRI-CS—3158, pp 2.24-2.49) **Cavitation damage in boiler feed pumps.** Cooper, P. (Ingersoll-Rand Research, Inc., Princeton, NJ); Antunes, F. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

This paper deals with the aspects of cavitatin damage only. This topic is far more complex than the traditional 3% head drop or suction specific speed guidelines. These latter limits pertain primarily to performance decay and unfortunately, as is shown, have little to do with cavitation damage on high speed equipment. With larger power plants and economic pressures for higher speed, cavitation damage has become a maintenance item; and average life, particularly for first stage impellers, appears to be approximately five years. It is hoped that this work will establish the need for cavitation erosion analysis and testing, hopefully improve part-load life, and establish new limits for the net positive suction head (NPSH) required to satisfactorily limit the cavitation erosion or the damage rate, a quantity which we here designate as NPSH/sub d/. These new NPSH/sub d/ limits can be expressed in terms of a ratio to the performance-NPSH which is usually designated as NPSH/sub R/. Many authorities are now referring to this ratio as the R-factor.

24724 (EPRI-CS—3158, pp 3.1-3.10) **New development in feed pump rotor/bearing systems.** Adams, M.L. (Case Western Reserve Univ., Cleveland, OH); Makay, E.; Diaz-Tous, I.A. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The work described in this paper summarizes the progress of an EPRI-sponsored effort to improve rotor vibrational performance of power plant feedwater pumps. A major objective of this effort is to reduce vibration levels by devising enhanced rotor vibrational damping capacity. Our approach to meeting this objective is threefold. First, squeeze-film damper/journal bearing designs specifically configured for feed pump applications have been built and are currently undergoing tests. Second, high-damping interstage fluid annuli (i.e., wear-ring surface geometries) have been devised and are about to be tested. Third, an axial squeeze-film damper-supported thrust bearing concept has been developed and is planned for testing next year. All of these new high-damping rotor support components are configured so that they can be easily used as retrofits on existing pumps as well as incorporated into new pump designs.

24725 (EPRI-CS—3158, pp 3.50-3.61) **Axial force balancing device in boiler feed pumps.** Makay, E. (Energy Research and Consultants Corp., Morrisville, PA); Diaz-Tous, I.A. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The rotors of boiler feed pumps develop very large axial-thrust forces that range up to 400,000 pounds. These forces are created by hydraulic pressures on the sideplates of the impellers and of other radial surfaces, and must be balanced in some way. The three customary approaches to balancing this axial thrust are: balancing disk, balancing drum (often called a balancing piston), and opposed impellers, together with an oversized thrust bearing for safety. Axial balancing devices often fail, for a variety of reasons. An investigation of 337 feed pump applications disclosed over 700 failures of balancing devices between 1975 and 1978. The number of disk-caused failures has declined significantly since the introduction of the tapered-face balancing disk and the enlarged-outer-diameter disk (three-piece design) on many boiler feed pumps. The tapered-face design has become standard for many manufacturers of boiler feed pumps. Both tapered-face and enlarged-disk design features are discussed here, together with other aspects of balancing devices.

24726 (EPRI-CS—3158, pp 4.1-4.6) **Feed pump problems arising from cyclic operation of large fossil power plants.** Kealy, W.R. (Florida Power and Light Co., Miami). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Cyclic operation of boiler feed pumps in large fossil-fueled power plants can reduce the service life expectancy of these pumps by significant percentages. Cyclic operation has accentuated problem areas that previously were of little concern because they occurred so infrequently that little attention was given them. Cyclic operation has also introduced new problems that did not exist when the plants were base loaded. The purpose of this report is to classify various feed pump problem mechanisms and show the relationship of these problems to plant design and operating procedures. Where applicable, design changes and modifications implemented or being considered are shown. These modifications are intended to make feed pumps more tolerant of cyclic operation. While this report is based solely on the experiences of one utility company, Florida Power and Light Company, it is possible that these experiences may be of value to others in this field. Florida Power and Light Company's plant designs, operating procedures, plant sizes,

feed pump drive systems, and feed pump designs present a fairly broad spectrum of conditions found in the power industry.

24727 (EPRI-CS—3158, pp 4.7-4.27) **System design for boiler feed pump reliability and low available NPSH.** Jones, M.W. (Potomac Electric Power Co., Washington, DC). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Boiler feed pump reliability is a major concern of most utilities. In many cases, however, nothing is done to define the causes of unreliability and to eventually correct these problems. Generally, problems that require only short downtimes will be corrected, but major changes requiring extended downtime periods will be difficult to justify economically. At PEPCO, a different situation occurred. The Chalk Point Generating Station was scheduled for major outages of six months for installation of new pollution-control equipment on each of the two units. This outage would provide the necessary time to implement any changes required to improve the reliability of the pumps. In order to quantify what changes would be required, a task force was set up to study causes of pump failures. Although the task force determined many factors which resulted in equipment failures, the underlying cause of these was the plant design philosophy that was prevalent in the industry when this plant was designed. Chalk Point Units 1 and 2 are 350 MW coal-fired base-load units. These units began service in the mid-1960's. In designing the plant, several items of design philosophy guided the selection of cycle and equpment. These philosophies and the results on plant design are discussed.

24728 (EPRI-CS—3158, pp 4.28-4.55) **Hydrodynamic variable speed couplings for boiler feed pumps (description and analysis).** Wiegmann, W. (Voith Transmissions, Inc., Allendale, NJ); Kozlowski, W.N. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

A discussion is presented of design features, reliability and economic considerations, including a brief case history of retrofitting a constant speed into variable speed standby (swinging) boiler feed pump. The purpose of this study is to evaluate the features, performance and the cost of variable speed fluid drives for boiler feed pump application with an economic comparison to throttle valves and a brief discussion of other variable speed drives.

24729 (EPRI-CS—3158, pp 4.56-4.73) **Hydroviscous variable speed drives - application and experience in power plant feed pumps.** Liu, J.K. (Philadelphia Gear Corp., King of Prussia, PA). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

This paper describes the application and experience of hydroviscous variable speed drives in power plant feed pump service.

24730 (EPRI-CS—3158, pp 4.74-4.99) **Development and design requirements for modern boiler feed pumps.** Florjancic, D. (Sulzer Brothers Ltd., Winterthur, Switzerland). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The boiler feed pump belongs to the group of turbomachines with the highest power concentration. The first aim of hydraulic and mechanical development efforts should be increasing feed pump availability, even at the cost of efficiency if necessary.

24731 (EPRI-CS—3158, pp 5.1-5.28) **Feed pump reliability and efficiency improvements resulting from hardware modifications.** Makay, E. (Energy Research and Consultants Corp., Morrisville, PA); Diaz-Tous, I.A. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The work described in this paper is the result of a successful EPRI-sponsored effort to improve reliability, hence availability of feed pumps and other large centrifugal pumps in utility applications. The results are directly applicable also to chemical process pumps, as well as to large water-injection pumps used in oil fields. The causes of many types of repeated failures are still unknown. Resolution of these problems requires more organized research and development efforts than those currently conducted by pump manufacturers and research institutes. Flow-induced vibration and pressure pulsation is a major failure cause that has started to show a logical trend. This phenomenon explains a range of observed problems: breakage of internal components, failure of external components, such as seal-water injection lines; feedwater system complications; malfunction of control valves and control systems; and, in some large generating units (both nuclear and fossil), frequent plant trip-outs. The underlying source has been traced to the geometric relationship between impeller exit and diffuser/volute inlet. This report outlines various failure modes and techniques that aid in identifying this mechanism and explains corrective measures.

24732 (EPRI-CS—3158, pp 5.46-5.53) **On-line monitoring of boiler feed pump alignment.** Baxter, N.L. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

This paper discusses the use of portable monitoring equipment to monitor the alignment of boiler feed pumps during operation. The equipment primarily consists of proximity probes mounted to bars on the driver and metal targets on bars attached to the driven unit. The DC offset, which is proportional to the distance between the probes and the targets, is indicated on a monitoring device. When the alignment changes, the readout device registers the change of alignment in mils. The body of this paper discusses how this technique has been used at a utility to successfully monitor alignment changes on boiler feed pumps.

24733 (EPRI-CS—3158, pp 5.54-5.72) **Boiler feed pump sound and its control.** Hoover, R.M. (Hoover Keith & Bruce Inc., Houston, TX); Makay, E. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Some typical sound spectra for loud pump installations are presented. What is known about the spectra, its generation, its prediction, and measures for control are then discussed.

24734 (EPRI-CS—3158, pp 5.73-5.76) **Recurring shaft breaks on Crystal River 2, boiler feed pumps.** Courtney, T.R. (Florida Power Corp., St. Petersburg). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

An analysis of shaft breaks on boiler feed pumps at the Crystal River 2 plant includes the history, probable causes of failures, and corrective actions taken.

24735 (EPRI-CS—3158, pp 6.1-6.18) **Feed pump hydraulic performance and design improvement.** Dunfee, J.D. (Franklin Research Center, Philadelphia, PA); Anwar, I.M.; Rusak, V.; Silvaggio, J.A. Jr.; Spring, H. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

This paper is a summary of work accomplished by the engineering staffs of the Franklin Research Center (FRC) and Transamerica Delaval Inc. (TDI) as part of a program sponsored by the Electric Power Research Institute (EPRI). The purpose of the program is the reduction of unscheduled outages in large fossil-fired plants through improvements in the design and application of large boiler feed pumps. The reduction of boiler feed pump problems and resulting unscheduled outages requires a two-pronged attack. The availability of existing feed pumps must be increased by improved methods of problem detection and subsequent design refinements in the pump hardware. New feed pump designs for future applications require research to upgrade the state of the art in design and testing procedures and in the methods of specifying and matching the system requirements to the pump design. The paper is a report on the state of the art of boiler feed pump design procedure obtained through surveys of the literature and pump manufacturers and con-

tinued evaluation of current pump problems previously studied by EPRI. It then gives a suggested coordinated approach to the reduction of boiler feed pump problems, in the form of a comprehensive research plan.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 24586, 24806

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 24803

24736 **Decomposition - coordination approach to modeling and optimization of power systems.** Gopalsami, N.; Sanathanan, C.K. (Argonne National Lab., IL). pp 245-252 of Modeling and simulation. Vol. 12, Part 1. Energy and the environment. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1981). (CONF-810477—Vol.1).

From 12. modeling and simulation conference; Pittsburgh, PA, USA (30 Apr 1981).

A two-level method of modeling optimization is presented for the load-frequency control of an interconnected power system. A decentralized control structure in accordance with the industrial practice of using integral "area control error" is assumed. In the first level, individual machines are decoupled and modeled in detail. Decoupling is accomplished by using infinite bus approximations. In the second level, aggregated models are used for the subsystems which are then interconnected to form a composite system. When the parameters of the two levels are optimized, one would invariably find discrepancies between the optimal values of the two levels, because of the interactions. A compromising solution between the two levels can be obtained by using the method of "satisfactory solutions" recently proposed by the authors. Certain advantages of this two-level approach are enumerated. Simulation results are included to illustrate the method and its computational feasibility.

21 NUCLEAR POWER PLANTS

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 24751

24737 **(IWGFPT—17) Influence of water chemistry on fuel element cladding behaviour in water cooled power reactors.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1983. 260p. (CONF-8306182—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE84900841.

From IAEA meeting on influence of water chemistry on fuel element cladding behaviour in water cooled power reactors; Leningrad, USSR (6 Jun 1983).

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Papers are presented concerning the corrosion behavior of fuel structural materials in power reactor circuits; water chemistry of reactors relevant to crud deposition and fuel cladding reliability; and monitoring of fuel deposits, water chemistry, and corrosion products in power reactor circuits.

24738 **(ORNL/TM—9054) Local stability tests in Dresden 2 boiling water reactor.** March-Leuba, J.; Fry, D.N.; Buchanan, M.E.; McNew, C.O. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010612.

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This report presents the results of a local stability test performed at Dresden Unit 2 in May 1983 to determine the effect of a new fuel element design on local channel stability. This test was performed because the diameter of the new fuel rods increases the heat transfer coefficient, making the reactor more responsive and, thus, more susceptible to instabilities. After four of the new fuel elements with a 9 x 9 array of fuel rods were loaded into Dresden 2, the test was performed by inserting an adjacent control rod all the way in and then withdrawing it to its original position at maximum speed. At the moment of the test, reactor conditions were 52.7% power and 38.9% flow. Both the new 9 x 9 fuel elements and the standard 8 x 8 ones proved to be locally stable when operating at minimum pump speed at the beginning of cycle in Dresden 2, and no significant difference was found between the behavior of the two fuel types. Finally, Dresden 2 showed a high degree of stability during control rod and normal noise type perturbations.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 24737, 24748, 24751

24739 **(EPRI-CS—3158, pp 5.29-5.45) Vibration analysis of a steam generator feedpump.** Fritsch, T.; Veilleux, M.J. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Analysis of the failure of a steam generator feedpump at the Maine Yankee Atomic Power Plant is presented. The two primary lessons learned from the failure experience are: (1) it is essential that adequate minimum flow recirculation systems be installed on large high energy pumps to protect them from major damage due to internal recirculation. (2) Sophisticated spectrum analyzers available today allow equipment users to quickly check, diagnose, and determine the feasibility of operating a suspicious piece of equipment.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 25144

24740 **Thermal hydraulic analysis of the annular flow helium heater design.** Chen, N.C.J.; Sanders, J.P. (Oak Ridge National Lab., TN). pp 1279-1283 of Modeling and simulation. Vol. 13, Part 4. Energy and environmental systems. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1982). (CONF-820463—Vol.4). Contract W-7405-ENG-26.

From 13. annual conference on modeling and simulation; Pittsburgh, PA, USA (22 Apr 1982).

A mathematical model was developed to evaluate thermal-hydraulic conditions of the annular flow helium heater design in support of a Core Support Performance Test in the High Temperature Gas-Cooled Reactor Program. The model accounts for the effects of convection and radiation heat transport, and the temperature-dependent resistivity of the molybdenum heating wire. The calculation has shown that a maximum molybdenum temperature occurred at the outlet and the temperature is below the maximum permissible limit. Consequently, there is a safe operating margin in this annular flow heater design.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 24747, 24749, 24755

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

24741 **(DOE/NBM—4009101) Some scoping experiments for a space reactor.** Alexander, C.A.; Ogden, J.S. (Battelle Columbus Labs., OH (USA)). 7 Jul 1983. Contract W-7405-ENG-92. 27p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009101.

Some scoping experiments were performed to evaluate fuel performance in a lithium heat pipe reactor operating at a nominal

1500K heat pipe temperature. Fuel-coolant and fuel-coolant-clad relationships showed that once a failed heat pipe occurs temperatures can rise high enough so that large concentrations of uranium can be transported by the vapor phase. Upon condensation this uranium would be capable of penetrating heat pipes adjacent to the failed pipe. The potential for propagation of failure exists with UO_2 and a lithium heat pipe. Changing the composition of the metal of the heat pipe would have only a second order effect on the kinetics of the failure mechanism. Uranium carbide and nitride were considered as potential fuels which are nonreactive in a lithium environment. At high temperatures the nitride would be favored because of its better compatibility with potential cladding materials. Compositions of UN with small additions of YN appear to offer very attractive properties for a compact high temperature high power density reactor.

2107 Regulation And Licensing

24742 **(NUREG/CR—3507) Safety goals for nuclear power.** Fischhoff, B. (Decision Research, Eugene, OR (USA)). Feb 1984. Contract W-7405-ENG-26. 47p. (ORNL/Sub—7576/2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84006685.

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The key policy question in managing hazardous technologies is often some variant of How safe is safe enough? The US Nuclear Regulatory Commission has recently broached this topic by adopting safety goals defining acceptable risk levels for nuclear power plants. These goals are analyzed here with a general theory of standard setting (Fischhoff, 1983) which asks: (1) Are standards an appropriate policy tool in this case? (2) Can the Commission's safety philosophy be defended? (3) Do the operational goals capture that philosophy? The anlaysis shows the safety goals proposal to be sophisticated in some respects, incomplete in others. More generally, it points to difficulties with the concept of acceptable risk and any attempt to build policy instruments around it. Although focused on the NRC's safety goals, the present analysis is a prototype of what can be learned by similarly detailed consideration of other standards, not only for nuclear power but also for other hazardous technologies, as well as for issues unrelated to safety.

22 NUCLEAR REACTOR TECHNOLOGY

2202 Components And Accessories

REFER ALSO TO CITATION(S) 24718, 24719, 24720, 24721, 24722, 24723, 24724, 24728, 24729, 24731

24743 (EPRI-CS—3158, pp 6.19-6.54) **Presentation of the feed pump performance and design improvement, Phase I: research program design report.** Fair, C.E.; Gopalakrishnan, S. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

As a result of prior EPRI-sponsored studies, it was concluded that a research program should be designed and implemented to provide an improved basis for the design, procurement, testing, and operation of large feed pumps with increased reliability and stability over the full range of operating conditions. This paper is a presentation of EPRI Report CS-2323 and contains a research plan which is based on a review of the present state of the art and which defines that necessary research and development program and estimates the benefits and costs of the program. The recommended research program consists of 30 interrelated tasks. It is designed to perform the needed research; to verify the results; to develop improved components; and to publish computer-aided design methods, pump specification guidelines, and a troubleshooting manual. Most of the technology proposed in the research plan is applicable to nuclear power plants as well as to fossil-fired plants.

24744 **(HEDL—7429) Swelling of AISI 304L in response to simultaneous variations in stress and displacement rate.** Porter, D.L.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA); Argonne National Lab., Idaho Falls, ID (USA)). 1984. Contract AC06-76FF02170. 8p. (CONF-840604—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007167.

From 12. international symposium on effects of radiation on materials; Williamsburg, VA, USA (18 Jun 1984).

The duration of the transient regime of neutron-induced swelling in annealed AISI 304L at 400°C is sensitive to both stress and displacement rate variations. The simultaneous application of both variables exerts a synergistic effect on the transient regime. The duration of this regime cannot be reduced below a required intrinsic exposure of ~ 10 dpa, however, which has been found to be characteristic of all Fe-Ni-Cr austenitic alloys. This is four times larger than that currently assumed in the stress-affected swelling equation for 20% cold-worked AISI 316.

2204 Control Systems

24745 **(NUREG/CR—3631) Response trees and expert systems for nuclear reactor operations.** Nelson, W.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1984. Contract AC07-76ID01570. 27p. (EGG—2293). NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84010223.

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The United States Nuclear Regulatory Commission is sponsoring a project performed by EG & G Idaho, Inc., at the Idaho National Engineering Laboratory (INEL) to evaluate different display concepts for use in nuclear reactor control rooms. Included in this project is the evaluation of the response tree computer based decision aid and its associated displays. This report serves as an overview of the response tree methodology and how it has been implemented as a computer based decision aid utilizing color graphic displays. A qualitative assessment of the applicability of the response tree aid in the reactor control room is also made. Experience gained in evaluating the response tree aid is generalized to address a larger category of computer aids, those known as knowledge based expert systems. General characteristics of expert systems are discussed, as well as examples of their application in other domains. A survey of ongoing work on expert systems in the nuclear industry is presented, and an assessment of their potential applicability is made. Finally, recommendations for the design and evaluation of computer based decision aids are presented.

2205 Environmental Aspects

24746 **Characterization of an aerosol sample from the auxiliary building of the Three Mile Island reactor.** Kanapilly, G.M.; Stanley, J.A.; Newton, G.J.; Wong, B.A.; DeNee, P.B. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Health Physics;* **45**: No. 5, 981-989(Nov 1983). Contract AC04-76EV01013.

Analyses for radioisotopic composition and dissolution characteristics were performed on an aerosol filter sample collected for a week by an air sampler located in the auxiliary building of the Three Mile Island nuclear reactor. The major radioisotopes found on the filter were ^{89}Sr, ^{90}Sr, ^{134}Cs and ^{137}Cs. Greater than 90% of both /sup 89-90/Sr and /sup 134-137/Cs dissolved within 48 h in an in vitro test system. Scanning electron microscopic analyses showed the presence of respirable size particles as well as larger particles ranging up to 10 μm in diameter. The major matrix components were Fe, Ca, S, Mg, Al and Si. Although the radionuclides were present in a heterogeneous matrix, they were in a soluble form. This information enables a better evaluation of bioassay data and predictions of dose distribution resulting from an inhalation exposure to this aerosol. Further, the combination of techniques used in this study may be applicable to the characterization of other aerosols of unknown composition.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 24745

2209 Reactor Safety

REFER ALSO TO CITATION(S) 24638

24747 (CONF-840411—18) Clinch River breeder reactor sodium fire protection system design and development. Foster, K.W.; Boasso, C.J.; Kaushal, N.N. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Clinch River Breeder Reactor Plant Project Office, Oak Ridge, TN (USA)). 13 Apr 1984. Contract AT03-76SF76026. 7p. NTIS MF A01; 2; GPO Dep. Order Number DE84008918.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

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To assure the protection of the public and plant equipment, improbable accidents were hypothesized to form the basis for the design of safety systems. One such accident is the postulated failure of the Intermediate Heat Transfer System (IHTS) piping within the Steam Generator Building (SGB), resulting in a large-scale sodium fire. This paper discusses the design and development of plant features to reduce the consequences of the accident to acceptable levels. Additional design solutions were made to mitigate the sodium spray contribution to the accident scenario. Sodium spill tests demonstrated that large sodium leaks can be safely controlled in a sodium-cooled nuclear power plant.

24748 (NUREG/CR—2691) Effects of cladding surface thermocouples and electrical heater rod design on quench behavior. Gottula, R.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1984. Contract AC07-76ID01570. 95p. (EGG—2186). NTIS, PC A05/MF A01; - GPO*; GPO Dep. Order Number DE84010350.

A separate effects experiment program was conducted on a bundle of nine electrical heater rods in the Loss-of-Fluid Test (LOFT) Test Support Facility (LTSF). The prototype cladding-embedded thermocouples did not function correctly during the experiment. Results indicate that (a) cladding external thermocouples had a negligible effect on the cooldown rate and the quench behavior of a cartridge-type heater rod under rapid (1 to 2 m/s) flooding conditions at high pressure, (b) cladding external thermocouples were selectively cooled during the quenching process and do not accurately measure cladding temperature during the part of the transient, and (c) the time-to-quench was significantly less for the cartridge-type heater rod than for the solid-type heater rod. The cartridge-type heater rod has been shown to satisfactorily simulate the thermal response of a nuclear fuel rod through analytical and experimental data comparisons; therefore, the results from the cartridge-type heater rod are considered applicable to LOFT nuclear fuel rods.

24749 (NUREG/CR—3224) Assessment of CRBR core disruptive accident energetics. Theofanous, T.G.; Bell, C.R. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 435p. (LA—9716-MS). NTIS, PC A01/MF A01; 1 - GPO $8.50; GPO Dep. Order Number DE84009164.

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The results of an independent assessment of core disruptive accident energetics for the Clinch River Breeder Reactor are presented in this document. This assessment was performed for the Nuclear Regulatory Commission under the direction of the CRBR Program Office within the Office of Nuclear Reactor Regulation. It considered in detail the accident behavior for three accident initiators that are representative of three different classes of events; unprotected loss of flow, unprotected reactivity insertion, and protected loss of heat sink. The primary system's energetics accommodation capability was realistically, yet conservatively, determined in terms of core events. This accommodation capability was found to be equivalent to an isentropic work potential for expansion to one atmosphere of 2550 MJ or a ramp rate of about 200 $/s applied to a classical two-phase disassembly.

24750 (NUREG/CR—3396) Experience with the shift technical advisor position. Melber, B.D.; Olson, J.; Schreiber, R.E.; Winges, L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 57p. (PNL—4783). NTIS, PC A04/MF A01; - GPO $4.50; GPO Dep. Order Number DE84009771.

The provision of engineering expertise on shift at commercial nuclear power plants has mainly taken the form of the Shift Technical Advisor (STA). This person, acting in a capacity that is part engineer and part operator, is expected to advise the operations crew in the event of an emergency and review plant operating experience during normal circumstances. The position was mandated by the Nuclear Regulatory Commission following the incident at Three Mile Island. This report expands on a growing body of knowledge regarding the effectiveness of the STA. The new data presented here come from interviews with plant personnel and utility officials from nine sites. Researchers from the Pacific Northwest Laboratory (PNL) interviewed plant personnel, including the STA and immediate management, the shift supervisor and management, the training department, and ancillary staff, all of whom affect the intended performance of the STA. The conclusions of the report are that the design of the STA position results in limited contribution during emergencies; more comprehensive ways should be sought to provide the variety and specificity of engineering expertise needed during such times.

24751 (NUREG/CR—3716) CONTEMPT4/MOD4: a multicompartment containment system analysis program. Lin, C.C.; Economos, C.; Lehner, J.R.; Maise, G.; Ng, K.K. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 281p. (BNL-NUREG—51754). NTIS, PC A13/MF A01; - GPO $7.00; GPO Dep. Order Number DE84009885.

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CONTEMPT4/MOD4 is a digital computer program that describes the response of multicompartment containment systems subjected to postulated loss-of-coolant accident (LOCA) conditions. The program is written in FORTRAN IV and can accommodate both pressurized water reactor (PWR) and boiling water reactor (BWR) containment systems. Also, both design basis accident (DBA) and degraded core type LOCA conditions can be analyzed. The program calculates the time variation of compartment pressures, temperatures and mass and energy inventories due to intercompartment mass and energy exchange taking into account user supplied descriptions of compartments, intercompartment junction flow areas, LOCA source terms and user selected problem features. Analytical models available to describe containment systems include models for containment fans and pumps, cooling sprays, heat conducting structures, sump drains, PWR ice condensers and BWR pressure suppression systems. Analytical models for hydrogen combustion within compartments and energy transfer due to gas radiation are also provided. The flexibility needed to more realistically model the complexity of prototypical containments is provided by the multicompartment capability (up to 999 individual compartments) and generalized user oriented input data descriptions. Descriptions of these analytical models are presented, together with input instructions for the CONTEMPT4/MOD4 program and sample problem results.

24752 Safety concept of nuclear power plants in the Federal Republic of Germany. Schnurer, H.L.; Seipel, H.G. *Nuclear Safety;* **24**: No. 6, 743-782(1983).

The safety philosophy of the Federal Republic of Germany (FRG) pertaining to nuclear power plants is presented. Its general approach makes much use of research and experience in other countries, especially the United States, but the FRG has also evolved approaches and aspects unique to itself. The article discusses the institutional interrelationships of the entities affecting German nuclear power plant safety and presents the resulting German safety philosophy. This philosophy is based, as in the United States, on multilevel defenses but with greater reliance on a number of accident-prevention and/or -mitigation concepts, including: (1) automated responses to off-normal conditions, (2) an operat-

ing-limit system that acts before initiation of protective actions by the reactor protection system, (3) multistrand independent safety trains, and (4) long-term self-contained safety under accident conditions without operator intervention. The practical realization of this philosophy in the design and operation of the chief reactor systems is described.

24753 **Nuclear liability insurance: the Price-Anderson reparations system and the claims experience of the nuclear industry.** Marrone, J. (American Nuclear Insurers, Farmington, CT). *Nuclear Safety;* **24**: No. 6, 783-791(1983).

The manner in which the Price-Anderson Law operates to provide reparations is reviewed, and the changes made in the law by Congress in 1975 are outlined. Nuclear liability insurers' response to the Three Mile Island accident is described, including emergency assistance funds advanced to qualified evacuees and the claims and litigations that followed. Other nuclear liability claims that have been asserted are described as being brought chiefly by onsite workers. Good health physics protection of workers is acknowledged, but the need to improve record keeping for transient workers is stressed. The nuclear industry is urged to implement a more effective record-keeping program for such workers.

24754 **Quality, peer review, and the achievement of consensus in probabilistic risk analysis.** Apostolakis, G.; Garrick, B.J.; Okrent, D. (Univ. of California, Los Angeles; Pickard, Lowe and Garrick, Inc., Irvine, CA). *Nuclear Safety;* **24**: No. 6, 792-800(1983).

This article addresses some of the issues that arise in connection with the problems associated with probabilistic risk assessment (PRA). Some opinions are given on quality assurance, PRA scope, and peer review. Then the issue of consensus and some of the reasons that lead to disagreement are discussed.

24755 **Component failure rates applicable to LMFBRs as derived from LER data.** Thaggert, H.L.; Jacobs, I.M. (General Electric Co., Sunnyvale, CA; Consulting Reliability Engineer, San Jose, CA). *Nuclear Safety;* **24**: No. 6, 801-808(1983).

This article provides failure-rate estimats that are considered applicable to liquid-metal fast-breeder-reactor control-rod drives, diesel generators, instrumentation and control components, pumps, valves, and primary containment penetration components. For each component, recommended, high, and low failure-rate estimates are provided. The failure rates developed are based on a modification of Licensee Event Report data provided in six Nuclear Regulatory Commission reports.

24756 **Nonsafety loads on Class 1E power sources.** Lewin, J. (Oak Ridge National Lab., TN). *Nuclear Safety;* **24**: No. 6, 809-820(1983).

The electric power distribution system that supplies the engineered safety features (ESFs) of a nuclear power unit is the most reliable source of power at the plant. Therefore there is incentive to power important nonsafety-related loads from this source. This has caused some concern for the integrity of the system in relation to its primary designated task. Both plant experience and generic evaluation by probabilistic risk assessment indicate that a judiciously and conservatively designed plant electrical system should not pose a significant threat to the operation of ESFs. However, each case should be examined carefully in the light of developing failure-rate data.

24757 **Cost-effectiveness considerations in reducing occupational radiation exposure in nuclear power plants.** Lochard, J.; Maccia, C.; Pages, P. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, Fontenay-Aux-Roses, France). *Nuclear Safety;* **24**: No. 6, 821-828(1983).

This article outlines a method of applying the as-low-as-reasonably-achievable principle to occupational radiation exposures in nuclear power stations. A set of protective actions already taken at French pressurized-water reactors now in operation were selected, and their cost and effectiveness were assessed, allowing for the possible interdependence of protection and energy-production objectives. The usefulness of such quantitative evaluation is discussed with regard to the problem of using monetary values of the man-sievert in optimization procedures.

24758 **Occupational radiation exposure at nuclear power plants in Japan and the United States.** Imahori, A. (Juntendo Univ. School of Medicine, Tokyo, Japan). *Nuclear Safety;* **24**: No. 6, 829-835(1983).

The annual statistical summaries of occupational exposures at nuclear power plants in Japan and the United States are compiled by reactor type for the years 1970 to 1980. The trends of occupational exposures at nuclear power plants in both countries are similar in many respects. Individual doses have been well controlled below the occupational dose limit (0.05 Sv/yr), but the collective doses (man-sieverts) have been increasing with plant age, especially in boiling-water reactors. Most of the occupational exposure at nuclear power plants is incurred during maintenance activities rather than routine operation; so the annual collective dose per unit of electric output is in inverse proportion to the annual plant capacity factor. An estimate of the cancer risk for the total number of workers exposed at commercial nuclear power plants in 1980 is fewer than ten hypothetical radiation-induced cancer deaths in the United States and fewer than three in Japan.

24759 **Reflections on the study of precursors to potential severe core damage accidents.** Okrent, D.; Guarro, S. (Univ. of California, Los Angeles). *Nuclear Safety;* **24**: No. 6, 836-850(1983).

This article examines Report NUREG/CR-2497, Precursors to Potential Severe Core Damage Accidents, 1969-1979 - A Status Report. Included are a summary of the contents of NUREG/CR-2497 and a review of the principal comments and critiques made by the Institute of Nuclear Power Operations, the Electric Power Research Institute, the Nuclear Regulatory Commission, and the Advisory Committee on Reactor Safeguards. Responses from the authors of NUREG/CR-2497 to these comments and critiques are summarized, and an attempt is made to identify the important issues emerging from the study and from the review process itself. An examination of some of the methodological problems involved in the study is also included.

25 ENERGY STORAGE

24760 **(CONF-830974—) Proceedings of the DOE physical and chemical energy storage annual contractors' review meeting.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Energy Systems Research). Sep 1983. 295p. NTIS, PC A13/MF A01. Order Number DE83017536.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

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Separate abstracts were prepared for the papers presented in the following areas of interest: (1) thermal energy storage for building heating and cooling and industrial applications; (2) solar thermal energy storage; (3) developmental thermal energy storage; (4) chemical/hydrogen energy systems; (5) mechanical energy storage; (6) superconducting magnetic energy storage; and (7) underground energy storage.

24761 (CONF-830974—, pp 171-172) **Regenerative braking through elastomeric energy storage.** Hoppie, L.O.; McNinch, J.H.; Nowell, G.C. (Eaton Corp., Southfield, MI). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Efforts focused toward improving the energy density and fatigue life of full-size elastomeric energy storage units, to be accomplished through materials and fabrication research, and toward the development of a compact method of mechanical attachment are described in this paper.

2501 Magnetic

24762 (CONF-830974—, pp 189-194) **30 MJ SMESSystem operating experience, November 1982-June 1983.** Schermer, R.I. (Los Alamos National Lab., NM). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This paper describes performance measurements on the dewar, coil, and cryogenic system for the 30 MJ superconducting magnetic energy storage (SMES) unit that has recently been tested at a Bonneville Power Administration substation in Tacoma, Washington. The cryostat, the world's largest fiber-reinforced plastic, open-mouthed dewar, boils off 12 l/h in accordance with previous calculations. Cyclic losses in te coil, 54 W for +- 8.4 MW modulation at 1 Hz, are approximately 50% greater than calculated. Refrigerator capacity is adequate to handle the heat produced by the average modulation demand on the coil.

24763 (CONF-830974—, pp 195-200) **Electrical tests of 30 MJ Superconducting Magnetic Energy Storage System within the Bonneville Power Administration Power Grid.** Hauer, J.F.; Boenig, H.J. (Bonneville Power Administration, Portland, OR; Los Alamos National Lab., NM). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

A 30 MJ Superconducting Magnetic Energy Storage (SMES) unit has recently been installed at the Bonneville Power Administration (BPA) substation in Tacoma, Washington. The unit was designed to be the modulated element in a control loop for damping the dominant swing mode on the Pacific ac Intertie, and can exchange up to +-10 MJ of energy at 0.35 Hz on a sustained basis. This paper describes the various operating modes and characteistics of the device, especially with respect to real and reactive power modulation, and summarizes the observed power system response to it.

2502 Compressed Gas

REFER ALSO TO CITATION(S) 24782

24764 (CONF-830974—, pp 201-204) **Overview of Underground Energy Storage Program.** Kannberg, L.D. (Pacific Northwest Lab., Richland, WA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The Underground Energy Storage (UES) Program encompasses research and development (R & D) in compressed air energy storage (CAES) and seasonal thermal energy storage (STES) technologies. Both CAES and STES have the potential to reduce energy consumption, employ current energy generation capacity more efficiently, and reduce reliance on other, more scarce, energy resources. The UES Program, managed by the Pacific Northwest Laboratory is aimed toward advancing both CAES adn STES concepts to the point of independent pursuit by the private sector. Thus, studies underway within the UES Program are limited to those leading to eventual elimination of the technical and economic uncertainties associated with the concepts, to encourage their timely implementation by industry, the utilities, and the public. This paper briefly traces the evolution of the Underground Energy Storage Program and describes its underlying objectives, structure, and approach. Progress achieved during fiscal year 1983 is summarized.

24765 (CONF-830974—, pp 205-210) **Field, laboratory and modeling studies in compressed air energy storage.** Doherty, T.J. (Pacific Northwest Lab., Richland, WA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The compressed air injection/withdrawal experiment at Pittsfield, Illinois, began operation in October 1982. Its objectives are to determine the feasibility of aquifer storage of compressed air for utility storage, to explore the validity of existing numerical models and laboratory predictions, and to provide stability criteria for this technology. The experimental facility was constructed and began operation under sponsorship of the US Department of Energy. It is currently owned and operated by the Electric power Research Institute. An extensive, relatively thin air bubble has been injected into the confined St. Peter sandstone 650 ft below ground surface. Cyclic injection/withdrawal tests are underway to simulate full-size plant operation with and without thermal storage and recovery. This paper discusses some of the background modeling and laboratory work done recently in support of this test and examines data from test operations to date.

24766 (CONF-830974—, pp 217-223) **Outlook for utility implementation of compressed air energy storage.** Hurwitch, J.W. (Battelle Columbus Labs., Washington, DC). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The US DEpartment of Energy has supported research and development on Compressed Air Energy Storage (CAES) since 1976 and has terminated their effort with the transfer of responsibility of the Pittsfield aquifer field test to the Electric power Research Institute. During the past seven years much has been accomplished to develop this technology from system designs and cost estimates to an engineering scale test facility for porous media. This research has shown that CAES is technologically ready and it will be up to the utility marketplace to successfully implement this systems option. The marketplace, although seemingly eager to adopt this technology, is fraught with uncertainty about the future of the industry. The financial health of the nation's utilities has been eroded. The demand for future power is uncertain as is the best methods for supplying this power and the determination of who is to pay for it. These global issues facing the utility community will directly impact the future for CAES. This paper focuses on several of these issues and discusses their impacts in terms of the future for CAES.

2505 Flywheels

24767 (CONF-830974—, pp 147-149) **Overview of the mechanical energy storage program.** Olszewski, M. (Oak Ridge National Lab., TN). Sep 1983. NTIS, PC A13/MF A01. Contract W-7405-ENG-26.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The Oak Ridge National Laboratory (ORNL) exercises field management responsibilities for the Department of Energy's Mechanical Energy Storage Technology (MEST) Program. In addition, the Oak Ridge Flywheel Evaluation Laboratory serves as the major testing facility for the MEST effort. During the past several years, spin testing of advanced composite flywheel designs has been the major focus of the program. In this past year, the testing activities have expanded to include cyclic fatigue tests in addition to the ultimate speed testing activity. This has been done in an effort to answer questions concerning lifetime and reliability. The results of these tests indicate that the hybrid disk/ring flywheel supplied by General Electric is capable of sustaining maximum energy densities (i.e., the energy density at ultimate speed) in excess of 60 wh/kg after being subjected to a 10,000 cycle fatigue test. Testing of a prototype containment housing was also performed. The unsuccessful test pointed to the need for better information concerning energy dissipation modes and debris management.

24768 (CONF-830974—, pp 156-163) **Flywheel containment design and technology developments.** Coppa, A.P. (General Electric Co., Philadelphia, PA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Experimental flywheel housings were designed and fabricated for performing containment tests of General Electric and Garrett Corporation composite rotors. One test was performed with a GE rotor which burst with a stored energy of 635 wh as compared with the design value of 262 wh. In addition, the rotor failure mode was particularly severe and unprecedented in all previous testing. Both factors contributed to producing gross rupture of the housing.

This was the first test ever performed involving a complete composite rotor burst within a realistic, vehicle-type housing. Post-test analysis revealed interesting, useful insights about the damage processes. Successful tests of loose-rotor type containment were performed with three General Electric hybrid rotors. Smooth acceleration from speeds as high as 41,000 rpm were obtained using realistic, rotable containment rings.

24769 (CONF-830974—, pp 164-170) **Flywheel and containment testing in FY 1983.** Babelay, E.F. Jr. (Union Carbide Corp., Oak Ridge, TN). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This paper summarizes the results and observations of flywheel spin tests conducted in the Oak Ridge Flywheel Evaluation Laboratory for the Mechanical Energy Storage Program at the Oak Ridge National Laboratory. Test results include the completed cyclic fatigue tests of two flywheels designed and fabricated by the General Electric Company and a flywheel designed and fabricated by Garrett-AiResearch. The ultimate speed evaluations of a flywheel designed by the AVCO Corporation and a Garrett flywheel and the evaluation of a General Electric lightweight containment housing are also reported.

2506 Thermal

REFER ALSO TO CITATION(S) 24683, 24703, 24704, 24764

24770 (CONF-830974—, pp 1-4) **Oak Ridge National Laboratory Thermal Energy Storage Program overview.** Martin, J.F. (Oak Ridge Y-12 Plant, TN). Sep 1983. NTIS, PC A13/MF A01. Contract W-7405-ENG-26.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Oak Ridge National Laboratory is the lead technical laboratory for DOE in the area of thermal energy storage technology development for building heating and cooling and industrial applications. The program of technical assessment and research and development is carried out in support of the national objectives of energy conservation and development of new energy sources. The activities supported by this program in FY 1983 are described. The major thrust of next year's program is given.

24771 (CONF-830974—, pp 5-10) **Thermal energy storage systems for industrial process and reject heat applications.** Petri, R.J.; Ong, E.T.; Marianowski, L.G. (Inst. of Gas Tech., Chicago, IL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

A novel thermal energy stoage (TES) media concept utilizing carbonate salts retained within the micro-porous structure of a ceramic matrix is being developed for such high temperature storage applications as industrial waste heat recovery/storage and solar thermal power systems. The composite carbonate salt/ceramic media can operate in direct contact with compatible working fluids, a feature which offers signiifincant potential for cost reduction and improved heat exchange performance over previous shell-and-tube molten salt TES designs. Results of the generic composite media development efforts, materials stability testing, and TES performance evaluations are discussed.

24772 (CONF-830974—, pp 11-14) **Structural properties of composite thermal energy storage media.** Harris, L.A. (Oak Ridge National Lab., TN). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Optical and scanning electron microscopy have been used to study microstructures of as-fabricated thermal energy storage pellets. These studies revealed a complex microstructure consisting of interconnected agglomerates composed of submicron particles of Na_2CO_3, $BaCO_3$, and MgO. In addition, calcium impurities were observed to form large $CaCO_3$ grains (containing about 10% Mg) when heated at 800°C for 5 days.

24773 (CONF-830974—, pp 29-34) **Studies on the R-12 gas hydrate formation process for heat pump cool storage applications.** Ternes, M.P. (Oak Ridge National Lab., TN). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

from a thermodynamic viewpoint the ideal cool storge medium would posses the following characteristics: (1) the storage medium should be a phase change material with a melting temperature comparable to acceptable delivery temperatures in standard HVAC practice; (2) the storage medium should have a large enthalpy of transition; (3) the storage medium should allow compact and efficient methods of heat transfer to be used. For residential applications, ice storage systems are by far the most common although storage systems using hydrated salts have also been demonstrated. However, based on a number of field test programs, the overall performance of ice systems has proven to be unsatisfactory. Consequently, the search for an ideal latent heat storage material for air conditioning service has led to an investigation of gas hydrates. Gas hydrates, which are a subset of the clathrate inclusion compounds, are composed of gaseous guest molecules contained withina crystalline water structure.

24774 (CONF-830974—, pp 35-40) **Two-phase fluid flow through a packed bed of PCM.** Arimilli, R.V. Pitts, D.R. (Univ. of Tennessee, Knoxville). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The governing equations describing the two-phase flow and heat transfer through a bed packed with encapsulated phase change material are presented. The experimental packed-bed test facility that was designed and fabricated is described. The facility uses Freon-12 as the working fluid. At the time of this writing, the detailed experimental study is about to begin and the analytical work on the development of numerical solution to the governing equations is in progress.

24775 (CONF-830974—, pp 41-45) **Chemically bonded olivine bricks.** Brosnan, D.A. (Materials Consultant Associates, Inc., Pell City, AL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Chemically bonded olivine castable compositions are developed for use in night storage heater cores. These compositions are fabricated by slurry casting followed by low temperature drying as opposed to conventional core materials which are pressed, fired brick shapes. The calcium aluminate cement bonded composition showed no deterioriation after 50 cycles in a 4 kW storage heater. Similarly a large monolithic shape of the same mix with a cast-in-place heating element exhibited no significant changes after component tests. Large complex shapes may be produced using these castable compositions.

24776 (CONF-830974—, pp 46-49) **System analysis of multiport diffuser stratified water system.** Sigmon, T.W. (Research Triangle Inst., Research Triangle Park, NC). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Following a brief description of the thermal energy storage system and a review of the scope of work involved in this study, findings based upon the on-site monitoring of the system that was conducted in CY1982 are presented. These results include component level performance for both conventional components as well as the thermal energy storage subsystem. Also given are summary energy use results for the system for this period and a brief description of other planned activities, the result of which were not available in time to allow their inclusion.

24777 (CONF-830974—, pp 54-58) **Advanced high-temperature molten-salt stoage research.** Copeland R.J.; Coyle, R.T. (Solar Energy Research Inst., Golden, CO). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The authors are researching advanced high-temperature molten-salt thermal storage for use in direct absorption receiver and thermal storage solar thermal systems. A molten salt at 900°C or higher is both the receiver heat transfer medium and the storage medium; a unique insulated platform (raft) separates the hot and cold medium in the thermocline thermal storage. We have measured raft performance experimentally, and it performs equally or better than a natural thermocline. Containment materials for the molten salts are being experimetnally screened. NaOH has a very high corrosion rate on ceramics and metals. Both carbonates and chlorides can be contained at 900°C with relatively little corrosion. Based on the measured corrosion rates, the economic potential of molten-salt thermal storage was analyzed. Both the chlorides and carbonates have potential (i.e., cost less than value) at the capacity of storage expected for commercial-scale solar themal systems.

24778 (CONF-830974—, pp 72-74) **Thermal energy storage utilizing materials with abnormally high heat capacities or large entropy change reactions.** Brewer, L.; Connick, R.E.; Phillips, N.E. (Lawrence Berkeley Lab., CA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Two approaches to thermal energy storage that avoid the kinetic factors associated with the use of phase transformations are being pursued. For highly charged cations in aqueous solution there are large entropy effects associated with complexing reactions. The values of temperature, pressure and concentration that optimize these effects for thermal storage applications are being investigated using recent advances in the theory of electrolytes. Materials with abnormally high heat capacities involving bond breaking are being studied using metallic cerium, in which the bond breaking occurs with changes in volume, as a model system.

24779 (CONF-830974—, pp 75-79) **Development of enhanced heat-transfer/transport/storage slurries for thermal-system improvement.** Kasza, K.E. (Argonne National Lab., IL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This paper presents a formulation of a new concept for improving thermal-system performance by utilizing the combined mechanisms of enhanced heat transfer, transport, and thermal energy storage associated with a phase-change slurry as the working fluid. The concepts presented are identified as being new, rewarding research activities.

24780 (CONF-830974—, pp 80-83) **Potential for conjugating binary solutions for thermal energy storage.** Grodzka, P.G. (Lockheed Missiles & Space Co., Inc., Huntsville, AL). Sep 1983. NTIS, PC A13/MF A01. Contract AC06-76RL01830.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The objectives of the present study were to identify promising conjugating bianry (CB) materials for utilization in chill storage for commercial building applications and to characterize CB-Thermal Energy Storage (TES) systems required for such applications including preliminary economics. It was found that the highest heat of mixing likely to be realized with a practical CB, i.e., water and an organic liquid, is about 70 Joules per gram. This value is high enough to make the economics of CB systems compare favorably with ice for commercial chill storage. The study also identified a couple of ways in which the energy storage capacity of CBs might be increased.

24781 (CONF-830974—, pp 84-87) **Potential for development of polymer-bound phase-change materials.** Schwerzel, R.E.; McGinniss, V.D.; Talbert, S.G. (Battelle Columbus Labs., OH). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

A wide variety of phase-change materials for heat storage have been proposed during the past few decades. Their commercial acceptance to date has been quite limited, however, primarily because of poor long-term stability and/or high cost. In this paper, a novel concept for self-protecting, electrically conductive phase-change materials based on carbon-filled polymers such as high-densiy polyethylene or poly(vinylidene fluoride). While further literature review and detailed experimental studies remain to be done, the concept appears at this time to have significant promise as a cost-effective means of heat storage.

24782 (CONF-830974—, pp 88-90) **Technical and economic analysis of energy storage technologies.** Mueller, R.O.; Michaels, A.I.; Asbury, J.G. (Argonne National Lab., IL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This report describes work by Argonne over the past year in areas related to the technical and economic analysis of physical and chemical storage technologies. Progress on two studies is described: (1) Analysis of the Federal Role in Energy Storage Research and Development; and (2) Development of an R & D Evaluation System.

24783 (CONF-830974—, pp 224-228) **Monitoring & analysis of a chill storage system.** Schaetzle, W.J.; Brett, C.E. (W.J. Schaetzle & Associates, Inc., Tuscaloosa, AL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Parisian, a major department store in University Mall, Tuscaloosa, Alabama, has a free cooling system installed to provide air-conditioning. The system uses a cooling tower during cold weather, below 47F wet bulb temperature, to chill water to an average 43F. The cold water is stored in an unconfined aquifer and recovered as required for air-conditioning on an annual basis. This contract provides monitoring of this system to evaluate system performance. The instrumentation has been installed and data taken. During the 1982-1983 winter, over 12,000 gallons of water were chilled and stored. The average chilling COP was 8.66. The water temperature of the recovered water has been higher than expected. During injection some problems existed with controls and the sand filter reducing water injection. Injection rates into the wells have been limited to 100 to 150 gpm, whereas withdrawal rates in excess of 300 gpm are available.

24784 (CONF-830974—, pp 229-233) **Thermal energy storage in confined aquifers using the doublet well configuration.** Melville, J.G.; Molz, F.J.; Gueven, O. (Auburn Univ., AL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

In March 1980 Auburn University began a series of aquifer thermal energy storage (ATES) experiments using the doublet well configuration. The test site, developed under prior DOE contracts, was in Mobile, Alabama. The objectives of the three experimental cycles were to demonstrate the technical feasibility of the ATES concept, to identify and resolve operational problems, and to acquire a data base for developing and testing mathematical models. Pre-injection tests were performed and analyses of hydraulic, geochemical, and thermodynamic data were completed. Three injection-storage-recovery cycles had injection volumes of 25,402 m^3, 58,010 m^3, and 58,680 m^3 and average injection temperautes of 58.5°C, 81.0°C, and 79.0°C, respectively. The first cycle injection began in February 1981 adn the third cycle recovery was completed in November 1982. Attributable to the doublet well configuration no clogging of injection wells occurred. Energy recovery percentages based on recovery volumes equal to the injection volumes were 56, 45, and 42%. Thermal convection effects were observed. Aquifer nonhomogeneity, not detectable using standard aquifer testing procedures, was shown to reduce recovery efficiency.

24785 (CONF-830974—, pp 234-239) **Numerical analysis of the Mobile, Alabama aquifer test facility.** Tsang, C.F.; Doughty, C. (Lawrence Berkeley Lab., CA). Sep 1983. NTIS, PC A13/MF A01. Contract AC03-76SF00098.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

For the past several years, Lawrence Berkeley Laboratory (LBL) has been doing numerical modeling studies using the numerical simulator PT, developed at LBL, to simulate and study the aquifer thermal energy storage field experiments conducted by Auburn University at a site near Mobile, Alabama. For the current year, the main task for LBL has been to perform: (1) detailed comparisons between fist- and second-cycle experimental and calculated temperatue distributions; (2) a parmeter study to examine the relative magnitudes and dependences of layering effects and buoyancy flow; and (3) the simulation of the third-cycle experiment.

24786 (CONF-830974—, pp 246-248) **Thermal-energy storage in a deep sandstone aquifer in Minnesota: field observations and preliminary modeling.** Miller, R.T. (Geological Survey, St. Paul, MN). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The United States Geological Survey has been studying the potential for storage and recovery of heated water in a deep sandstone aquifer in the state of Minnesota, in the north-central United States. The Geological Survey has designed a data-collection network, collected and analyzed field data to describe the hydrogeologic properties of the aquifer, and constructed several computer models to simulate groundwater flow and thermal-energy transport. Several computer models have been used to study the sensitivity of hydraulic and thermal model input parameters and to make preliminary examinations of the efficiency. Sensitivity analysis indicates that in short-term heat injection, rock-heat capacity is the least sensitive property and thermal dispersivity the most sensitive. Preliminary model simulations indicate that injection/withdrawal rates and duration of heat storage can significantly affect the overall efficiency of the aquifer thermal-energy storage system.

24787 (CONF-830974—, pp 249-252) **Charaterization of important physicochemical processes occurring at the St. Paul Field Test Facility: an interim report.** Blair, S.C.; Deutsch, W.J. (Pacific Northwest Lab., Richland, WA). Sep 1983. NTIS, PC A13/MF A01. Contract AC06-76RL01830.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Studies of physicochemical processes occurring at the Aquifer Thermal Energy Storage Field Test Facility in St. Paul are being conducted using a combination of the following techniques: (1) laboratory-scale flow tests at elevated pessure and temperature on core samples from the reservoir formation; (2) on-site core flooding and membrane filter tests; and (3) geochemical analysis and modeling of chemical reactions in the aquifer system. Preliminary results of these studies indicate that significant dissolution/precipitation reactions may be occurring in the St. Paul storage aquifer. While these reactions have not affected operation of the site to date, potential effects include near-well plugging and significant changes in reservoir hydrodynamics.

24788 (CONF-830974—, pp 253-258) **Development of a predictive tool for unconfined aquifer thermal energy storage.** Haitjema, H.M.; Strack, O.D.L. (Univ. of Minnesota, Minneapolis). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

A computer pogram UCATES has been developed to simulate thermal energy storage in unconfined aquifers. The program is a first step towards a comprehensive screening tool for projected thermal energy storage systems in unconfined aquifers. In its present form, the program models convective heat transport due to transient groundwater flow. The groundwater flow problem is mathematically described by a non-linear differential equiation which is solved by superposition of analytic functions. Changes in the aquifer storage are modeled by newly developed areal sink distributions. This semi-analytic approach eliminates the occurrence of numerical dispersionin solving the heat transport equation. Heat loss occurs through the upper and lower aquifer boundaries; the vadose zone and the aquifer base. Only vertical heat conduction is considered in these boundaries, which is modeled in an approximate fashion. In this paper, UCATES is applied to two examples of thermal energy storage under regional flow conditions in unconfined aquifers. The first example deals with the loss of thermal energy due to regional uniform flow. The second example shows a thermal energy storage system near creeks and a domestic well.

24789 (CONF-830974—, pp 259-263) **Numerical model for analysis of multiple well aquifer thermal energy storage systems.** Vail, L.W.; Kincaid, C.T. (Pacific Northwest Lab., Richland, WA). Sep 1983. NTIS, PC A13/MF A01. Contract AC06-76RL01830.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

numerical models can help identify the optimal policy for managing aquifer thermal energy storage (ATES) systems. Pacific Northwest Laboratory has developed a simple model to analyze the effects of various injection/pumping policies on the thermal efficiency of multiwell ATES systems. The model uncouples thermal and hydraulic phenomena by neglecting thermally induced variations in density and viscosity. Thermal convection and conduction are simulated along each of a finite number of independent streamline planes. This paper presents the model's conceptual basis and discusses a 25-well ATES simulation case.

24790 (CONF-830974—, pp 264-270) **Investigation of thermal energy storage and heat exchange capacity of water-filled mines - Ely, Minnesota.** Walton, M.; McSwiggen, P.L. (Univ. of Minnesota, St. Paul). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Old mine maps, pumping records and records of the total volume of iron ore mined at Ely show that the mine now contains 469 to 595 million ft^3 of water in shafts and drifts surrounding the ore body, in interstices in the rubble now filling the collapsed stopes, and in a deep pit formed by subsidence of the ground above the mine workings. The three accessible shafts were sounded with a temperature probe, water samples were collected, and resuts of pumping tests made by others in two shafts were made available. The underground workings are hydraulically interconnected throughout a mined area 8550 ft (2606 m) long, 1350 ft (411 m) wide, and as deep as 1672 ft (510 m). The underground water is stratified in three layers, separated by sharp thermoclines and chemoclines: (1) a deep mineralized layer at about 54°F (12.2°C), (2) an intermediate, weakly mineralized layer at about 51°F (10.6°C) and an upper layer comparable to shallow ground water near 47°F (8°C). The pit develops a sharp thermocline in the summer with water above 70°F (21°C) over an area of 5.4 million ft^2 (500,000 m^2) and 10 ft (3 m) deep. Water circulation systems must be developed to use the heat storage capacity of the mine in the winter and replenish the heat with solar input from the summer.

24791 (CONF-830974—, pp 278-282) **Investigation of the potential for passive generation and storage of winter chill by formation of refrigerant clathrate hydrates.** Gorski, A.J.; Schertz, W.W. (Argonne National Lab., IL). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

This project is an investigation of the potential for passive generation and storage of winter chill by formation of refrigerant clathrate hydrates. An extensive literature review has been conducted to obtain information on the characteristics of various refrigerants for passive formtion of clathrate hydrates. Experimental efforts included the formation of clathrates of R-11 (CCl_3F), tetrahydrofuran (C_4H_8O), and methylene chloride (CH_2Cl_2). Results indicate that a congruent clathrate material should be used in a passive generation technique. Ten possible congruent hydrate formers have been identified to date. A conceptual design of a hybrid system, freezing both water-ice and clathate-ice, has been developed. The hybrid system allows climatic tuning in terms of the required volumes of ice and clathrate for a given geographic location. Low cost hydrate formers as well as hybrid systems are being evaluated for different site locations and differing economic environments. This work is still in progress.

2508 Chemical

24792 (CONF-830974—, pp 91-96) **Chemical/hydrogen energy systems progam overview.** Mezzina, A. (Brookhaven National Lab., Upton, NY). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Brookhaven National Laboratory has been charged with the field management responsibility for R & D in the area of Chemical and Hydrogen Energy Systems since 1975. The current program reflects federal policy and budgetary guidance which have formed the basis for developing project priorities and associated budgetary allocations.

2509 Batteries

24793 **(BNL—34390) Rechargeable zinc batteries.** McBreen, J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 19p. (CONF-840279—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008947.

From 6. Australian electrochemistry conference; Geeland, Australia (19 Feb 1984).

This article reviews the current status of the research and development programs, in the USA, on rechargeable zinc batteries. The review is confined to systems that are now under development. These are the zinc-bromine, zinc-chlorine, zinc-ferricyanide and zinc-nickel oxide systems. Most of the electrochemical problems with these batteries are due to the zinc electrode. Recent advances in zinc batteries include the use of additives and modified charging methods. Recent work by the author and others on the mechanism of the zinc electrodes in acid electrolytes is discussed and the mechanistic aspects of the effect of additives and charging methods is also reviewed.

24794 **(LBL—17397) Active material redistribution rates in zinc electrodes: effect of alkaline electrolyte compositions having reduced zinc oxide solubility.** Nichols, J.T.; McLarnon, F.R.; Cairns, E.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1983. Contract AC03-76SF00098. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010709.

Portions are illegible in microfiche products; Thesis. Submitted by J.T. Nichols.

A series of electrolytes with low hydroxide concentration (~ 3.5M OH^-) have been tested in 1.35 Ah tri-electrode Zn/NiOOH cells for their ability to reduce zinc redistribution rates. Three electrolytes were evaluated: a 3.5M OH^- electrolyte, a 3.5M OH^- to 3.4M F^- electrolyte, and a hydroxide-borate electrolyte. The electrolytes were chosen to have a ZnO solubility approximately 25% of that in the standard 30% KOH-1% LiOH electrolyte (7.4 M OH^-). A 6-hour charge rate and a 2.5-hour discharge rate were employed for the Teflon-bonded, zinc oxide electrodes, to which 2% PbO was added to reduce hydrogen evolution. The zinc redistribution rates were found to be lower for the electrolytes with reduced ZnO solubility. In addition, no zinc penetration of the separator occurred for some of the electrolytes, even with overpotentials of 100 to 290 mV. After 125 cycles, none of the cell capacities were limited by the zinc electrode during discharge, less than 2% inactive zinc was found in the zinc electrodes cycled in the hydroxide-fluoride and borate electrolytes.

29 ENERGY PLANNING AND POLICY

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 24604, 24860

24795 **(DOE/CS/20448—T1) Energy conservation.** (Mercer County Energy Development Board, Hazen, ND (USA)). Jan 1979. Contract AC01-78CS20448. 266p. NTIS, PC A12; 3; GPO Dep. Order Number DE84010744.

Paper copy only, copy does not permit microfiche production.

These briefing materials were prepared for a program to develop a coordinated approach to energy-related community development. The purpose of this briefing book is to provide the most significant highlights of the 4-year Mercer County experiment, along with references to and sources of more detailed information. This briefing book was into four sections that reflect the four project phases. These are: overview of the problem, general organizational approach, the Mercer County Experiment, and transferring the general approach. A chronology of major events that occurred during the 4-year project period is provided. This overview includes contractual milestones, as well as more specific, significant events of the Energy Development Board (EDB) and of Mercer County, North Dakota.

24796 **(DOE/CS/20448—T3) Second workshop on the Energy Development Board of Mercer County, North Dakota: participants briefing booklet.** (Resource Planning Associates, Inc., Washington, DC (USA)). 1978. Contract AC01-78CS20448. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010741.

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Workshop panel discussions were planned for the following: growth management, energy conservation, economic diversification, monitoring the impact of energy development, and energy impact assistance. This briefing booklet contains a workshop agenda, material on each panel topic, lists of participants by panel, and some general information on the workshop.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 25071, 25072

24797 **(DOE/EV/10661—T1) Impacts of synthetic fuels development.** Masselli, D.C.; Dean, N.L. Jr. (National Wildlife Federation, Washington, DC (USA)). Sep 1981. Contract FG01-81EV10661. 140p. National Wildlife Federation, 1412 16th Street, NW, Washington, DC 20036.

The objective was to present some insight into three aspects of synthetic fuels technology. The resource base and the different technical approaches to producing useable fuels from the resource are examined. The potential impacts of various synthetic fuel technologies on air quality, water quality and quantity, environmental safety and health, land use and the socioeconomic stability of affected communities are examined. Existing standards designed to control these risks and mechanisms and approaches which can be taken by synfuel developers to meet these standards are discussed.

2904 Natural Resources

REFER ALSO TO CITATION(S) 24609

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 24664

24798 **Providing R and D test fuels from alternate energy sources: an assessment of options.** Washington, DC; National Academy Press (1983). 77p. Aeronautics and Space Engineering Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418.

A committee was formed at the request of the Air Force to assess whether the US needs to provide the research and testing facilities for synthetic fuels derived from alternate energy sources. The committee concluded that the need exists, and that peacetime use of synthetic fuels by commercial aviation will likely exceed that of military use. Specific conclusions note the need for a variety of synthetic test fuels, with the recommendation made for a centrally coordinated research and test program. The report outlines a procedure for meeting the requirements and managing the program. Five appendices describe different types of existing DOE and Department of Defense facilities. 68 references, 12 figures, 14 tables.

24799 **Energy research, development and demonstration. Annual report on activities of the IEA, 1982/83.** Paris, France; International Energy Agency (1983). 194p. International Energy Agency, Energy Research, Development and Technology Applications, 2 rue Andre-Pascal, 75775 Paris CEDEX 16, France.

The 21 industrial countries of the International Energy Agency agreed to carry out national and cooperative energy research, development, and demonstration programs on both conventional and non-conventional energy systems. The 1982-83 annual report summarizes these activities under the national programs, reviews of key energy technologies (specifically recommendations on district heating and combined heat and power), and cooperative projects. The latter cover energy technology systems analysis, end-use efficiency, fossil fuels, renewable energy technologies, hydrogen production, and fusion energy. Two appendices include 43 pages of references and a list of operating agents. 20 figures, 4 tables.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 24598, 24742

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 24863, 24865, 24880, 24891

2910 Conservation

REFER ALSO TO CITATION(S) 24813, 24814, 24815, 24816, 24846, 24856, 24897

24800 (DOE/CE/40596—T1, pp 265-269) **Corporate energy management at Western Electric.** Mulhern, T.A.; Elder, L.A. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The Energy Management Program developed by the Western Electric Company is presented. The program includes managerial accountabilities; administrative and technical activities; and a recently implemented comprehensive five-year energy planning process. The planning process is designed to: (1) provide increased Corporate energy direction; (2) assure that all Company locations have comprehensive energy management programs; (3) improve communications to reduce duplication of effort; (4) provide engineering effort and capital required for energy related projects; and (5) provide increased energy conservation input to the Corporate Business Plan.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 24861

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 24598, 24604, 24609, 24795, 24796, 24797, 24797

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 24795, 24796, 24797, 24798

2960 Electric Power

REFER ALSO TO CITATION(S) 24598

24801 **(DOE/BP—205) 1983 annual report.** (USDOE Bonneville Power Administration, Portland, OR). Feb 1984. 52p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84008585.

This is the annual report of Bonneville Power Administration. In this report subjects dealing with the following are covered: revenue, finance, energy accounting forecasting, strategies, legal/political, ecology, cost-reduction, conservation, rate features, and construction.

24802 **(DOE/ER—130) Projections of cost and on-site manual labor requirements for constructing electric generating plants, 1980-1990.** (Department of Labor, Washington, DC (USA)). Feb 1982. Contract AI01-76IR02567. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009740.

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This report is an update of an earlier monograph Projections of Cost Duration, and On-Site Manual Labor Requirements for Constructing Electric Generating Plants, 1979-1983. These reports represent a continuing effort by the Federal Government to forecast the capital and labor required for constructing electric generating capacity additions necessary to accommodate projected economic and population growth in the United States and its regions.

24803 **Reliability from the customer's viewpoint.** McNitt, M.; Morgan, G.; Callaham, M.; Talukdar, S. (Carnegie-Mellon Univ., Pittsburgh, PA). pp 101-105 of Modeling and simulation. Vol. 12, Part 1. Energy and the environment. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1981). (CONF-810477—Vol.1). Contract AC02-77ET29139.

From 12. modeling and simulation conference; Pittsburgh, PA, USA (30 Apr 1981).

A framework is presented for examining the effects of dispersed generation and storage on the customer's perception of reliability.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 24662, 24664, 24810, 24811, 24812

24804 **(DOE/CE/15095—14) Appropriate Technology Management Information System.** (National Center for Appropriate Technology, Butte, MT (USA)). Feb 1984. Contract AC01-82CE15095. 763p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84010952.

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From 1978 to 1981, the Department of Energy (DOE) awarded more than 2200 small grants worth more than $25 million to individuals, organizations and small businesses across the nation for the purposes of researching, developing and demonstrating appropriate technologies. Grants were given in the full range of technology areas, including conservation, solar, biomass, wind, geothermal, and hydro power. The final report from each DOE grantee was reviewed in an effort to extract information about new ideas and proven concepts that could be of value to the public. To manage the growing wealth of information from the grant reports, and to monitor the report review process, the Appropriate Technology Management Information System (ATMIS), a computer data base, was developed. The ATMIS can classify data into numerous categories (technology area, geographic location, project status, etc.). This manual was generated directly from the data base.

24805 **(DOE/ER/10250—T2) Exploratory energy research program of the University of Hawaii at Manoa. Progress report.** (Hawaii Univ., Honolulu (USA)). 1984. Contract FG03-81ER10250. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008843.

Progress is reported from the University of Hawaii on: UHM rooftop solar energy laboratory; solar pond cleansing techniques; combustion properties of biomass pyrolysis products; high-temperature solar concentrator absorber; biological abatement of hydrogen sulfide during geothermal energy production; geothermal systems on submarine rift zones of the Hawaiian chain; nitrogenous products of OTEC chlorination; interaction of hydrogen and deuterium with transition metals and their alloys at high pressures; shallow magma chambers and geothermal potential of Haleakala, Maui; effects of OTEC waste water on phytoplankton; sodium-lithium

geothermometer; breaking wave forces on OTEC pipes; seismic and thermal properties on basalts. (PSB)

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

24806 **(CONF-840667—1) The effect of boiler flow distribution on NO decomposition.** Chow, L.S.H.; Lyczkowski, R.W.; Wang, C.S.; Berry, G.F. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006740.

From 22. symposium on engineerings aspects of MHD; State College, MS, USA (26 Jun 1984).

In an MHD plant, the coal combustor produces combustion gases at a temperature of about 2800 K, resulting in the production of large amounts of nitric oxide, as much as 10,000 ppM or higher. This high level of NO must be reduced to about 550 ppM before leaving the stack to meet the emission standards of the Environmental Protection Agency (EPA). Calculations and experiments have shown that a gas residence time of about 2 seconds in an MHD radiant furnace at gas temperatures above 1800 K is required for NO relaxation. This requirement can be met for a radiant boiler of a full size MHD plant if the gas flow in the boiler approximates plug flow. However, for a real boiler, flow recirculation especially around the inlet driven by the diffuser exhaust could adversely affect NO decomposition. For a smaller plant or a small-scale test facility, in addition to the flow recirculation problem, the gas residence time in the boiler is, in general, shorter than the required two seconds. Thus, the knowledge of residence time as well as the flow profile within the radiant boiler are essential in (1) the interpretation of the measured NO data from a small facility and (2) the extrapolation of such data for the design of larger plants. Computer calculations are described.

24807 **(CONF-840667—2) Review and assessment of slagging and fouling in MHD steam plants.** Chow, L.S.H.; Smyk, E.B.; Johnson, T.R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006741.

From 22. symposium on engineerings aspects of MHD; State College, MS, USA (26 Jun 1984).

The issues that affect the slagging and fouling in MHD steam plants are (1) deposition rates, (2) deposit composition and structure, (3) strength and tenacity of the deposits, and (4) seed-slag interaction. There is a need for a solid base of technical information in these areas. To enable the designers to make trade-offs and to optimize the system, these data must be obtained over a wide range of probable operating conditions and, if possible, reliable computer models should be provided.

3005 Fuel Cells

24808 (CONF-830974—, pp 106-111) **Oxide electrodes on yttria stabilized zirconia electrolytes at high temperatures.** Wirtz, G.P. (Univ. of Illinois, Urbana). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The overall objective of this study is to elucidate problems peculiar to the oxygen electrode on a high temperature fuel cell when reversed for use as an electrolyser. The cell is based on a yttria stabilized zirconia (YSZ) electrolyte.

24809 **(DOE/MC/20212—1569) Effects of H_2S on molten carbonate fuel cells.** Remick, R.J.; Anderson, G.L. (Institute of Gas Technology, Chicago, IL (USA)). Apr 1984. Contract AC21-83MC20212. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010485.

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This report summarizes the results of a literature survey conducted by the Institute of Gas Technology (IGT) under Phase I of a multi-phase program to investigate and identify the mechanism(s) responsible for molten carbonate fuel cell (MCFC) performance losses when operating on sulfur-containing gases. The objective of this literature survey was twofold: (1) to review the reported data on the interaction of H_2S with nickel-containing materials; and (2) to review reported investigations on the specific effects of H_2S on the electrochemical oxidation of H_2 in MCFC. The ultimate goal of this literature review is to determine the poisoning mechanism. 21 references.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 24800, 24804

24810 **(DOE/CE/15151—1-Vol.1-Exec.Summ.) Appropriate Technology Small Grants Program evaluation. Volume I. Executive summary.** (Cardinal Management Associates, Inc., Washington, DC (USA)). Mar 1984. Contract AC01-82CE15151. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010675.

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Volume One contains the Executive Summary which provides a concise overview of the study, including a brief description of the Appropriate Technology Small Grants Program and of the study methodology, highlighted key findings and the Evaluation Team's policy recommendations.

24811 **(DOE/CE/15151—1-Vol.2) Appropriate Technology Small Grants Program evaluation. Volume II.** (Cardinal Management Associates, Inc., Washington, DC (USA)). Mar 1984. Contract AC01-82CE15151. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010674.

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An introduction to the Appropriate Technology Small Grants Program Evaluation is presented. Program background is presented, including history, guidelines and operation. The evaluation methodology is presented, specifically the problem statement, study limitations and study methodology. The findings of the study are presented and policy recommendations are discussed.

24812 **(DOE/CE/15151—1-Vol.3) Appropriate Technology Small Grants Program Evaluation. Volume III. Case studies.** (Cardinal Management Associates, Inc., Washington, DC (USA)). Mar 1984. Contract AC01-82CE15151. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010673.

Portions are illegible in microfiche products. Original copy available until stock is exhausted.

Case studies of twenty successful Appropriate Technology Small Grant Program recipients are presented. The case studies cover solar energy, energy conservation, wind power, methane generation, photovoltaics, energy management, recycling, and heat recovery. (MHR)

24813 **(DOE/CE/40596—T1) Advances in energy productivity. Proceedings of the 5th World Energy Engineering Congress, September 14-17, 1982.** (Association of Energy Engineers, Atlanta, GA (USA)). 1982. Contract FG01-82CE40596. 454p. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

Separate abstracts were prepared for seventy-eight papers. (MHR)

24814 (DOE/CE/40596—T1, pp 233-235) **Energy conservation accounting programs.** Dougherty, J.N.; Foley, D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

A system designed to measure, analyze, and report energy conservation performance is an essential component of any effective energy conservation program. Techniques for evaluating

energy conservation performance of an energy cost center, a plant, a building, or an enire organization are described.

24815 (DOE/CE/40596—T1, pp 237-241) **Life cycle costing and risk analysis.** Baker, J.M. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

A risk analysis method is presented which allows ranking of energy projects by their expected life cycle cost (LCC) values and the uncertainty surrounding these values. The inputs consist of a low, most-likely, and high value for each LCC cost element, such as construction costs and energy price projections. The model uses existing microcomputer software and provides powerful capabilities for what if projections, sensitivity and risk analyses, and management decision making.

24816 (DOE/CE/40596—T1, pp 259-260) **Exergy management: the definitive thermoeconomic assessment of energy.** Soma, J.; Krochmal, R.S.; Morris, H.N. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Exergy management is based on the proposition that the Laws of Thermodynamics and sound economic principles represent the proper assessment of energy. Unlike energy management with is endemically a First Law practice, it embraces the Laws of Thermodynamics in economic concert with capital, resource and labor considerations. Exergy management's goal is not energy conservation per se, but optimum productivity through energy leveraging of an activity's elements of productivity within extant degrees of freedom and return-of-investment criteria.

3201 Buildings

REFER ALSO TO CITATION(S) 24686, 24692, 24693, 24783

24817 (CONF-830974—, pp 143-146) **Heat/mass flow enhancement design for a metal hydride assembly.** Argabright, T.A.; Rohy, D.A. (Solar Turbines Inc., San Diego, CA; Southern California Gas Co., Los Angeles). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Southern California Gas Company and Solar Turbines Incorporated are cooperating in the development and demonstration of a novel metal hydride heat pump (MHHP). The MHHP is a chemical heat pump containing two different metal hydrides. The concept is based on the ability of selected metals to absorb and desorb hydrogen without the consumption of metal or hydrogen. The MHHP can be tailored to provide heating and/or cooling, or temperature upgrading over a wide range of temperatures and, thus, can be used with a variety of heat sources. In this project, because the MHHP is a cyclical device, heat transfer is considered to be the key technical study area. High heat transfer leads to rapid cycling, high capacity, low hydride inventory per unit output and low system costs. Due to the cyclic nature of this device, the parasitic self-heating and cooling losses of the structure must be reduced. Therefore, the goal of this project is to provide high heat transfer with a low mass unit.

24818 (DOE/CE/22094—T1) **Guidelines for the design and purchase of energy management and control systems for new and retrofit applications.** (ACEC Research and Management Foundation, Washington, DC (USA)). Mar 1984. Contract AC01-82CE22094. 40p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010736.

The definition, principles, and historical perspective of automatic control are presented. The primary functions of an energy management and control system (EMCS) and building-related factors impacting EMCS application are discussed. Technical considerations, concept design, implementation, and trends in EMCS are included. (MHR)

24819 (DOE/CE/40596—T1, pp 37-44) **Realistic engineering approach to significant retrofit energy conservation in typical medium-sized hospital facilities.** Jhaveri, A.G. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

In a general-purpose, typical, medium-sized (200-plus beds) central Washington hospital, constructed during 1960's, a comprehensive energy conservation retrofit program resulted in nearly 25% overall savings, majority of which was provied by mechanical/HVAC, electrical, and architectural design modifications and/or systems replacement. Based on detailed Technical Assistance (TA) energy analysis of the hospital's major energy consuming systems and equipment, the hospital was awarded one of the largest single grant (nearly one-half million dollars as 50% match) by the US Department of Energy (DOE) under its Institutional Buildings Grant Program (IBGP). In addition to the cost-effective building envelope (e.g., insulation, storm windows, solar control film, etc.) and electrical power (e.g., power factor controller, energy-efficient lighting replacement) system retrofit modifications, the hospital's two existing 300-ton (each) natural gas-fired units were replaced with similar electric centrifugal chillers; existing heat recovery system was modified for improved energy efficiency; zone optimization controls wre installed; and new boiler stack heat recovery system was equipped on the largest of the three boilers. Relevant engineering and design approaches used in this highly effective energy conservation retrofit project are provided.

24820 (DOE/CE/40596—T1, pp 45-48) **Energy management computerized system.** Buford, D.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

How McDonnell Douglas Corporation was able to meet energy crunch needs with an Energy Management Computerized System (EMCS) is described. EMCS consists of equipment and computer software that will monitor and/or control energy use within a particular building or group of buildings. The use of EMCS as a tool for optimizing energy efficiency while maintaining desired environmental comfort standards and reducing energy cost is described. Functions vary from simple time clock shedules, to sophisticated schedules that use a computer program to monitor and control equipment operation as related to the building operation schedules, utility demands and actual outdoor weather conditions. MECS gathers data and prepares reports of energy usage and equipment operation as a function of building occupancy schedules and global weather conditions. Hardware, report capabilities, monitoring/control systems, data gathering features, utility demand shedding methods, impact on energy budgets and maintenance planning are discussed.

24821 (DOE/CE/40596—T1, pp 49-53) **Use of the energy utilization index in energy surveys for generic buildings.** Hodge, B.K.; Steele, W.G. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The concept of using a target Energy Utilization Index (EUI) to determine the energy usage in efficiently operated and maintained buildings of the same generic type is investigated. The thermally light building types considered are schools and local government buildings which have daytime occupancy only. Target EUI increments for electricity and fuel usage were verified by comparison with energy usage data from efficiently run buildings. Current usage EUI's are given for eighty-four buildings, and examples of the use of the target EUI for determining energy savings are given for seven of these.

24822 (DOE/CE/40596—T1, pp 55-60) **Proposed method for the selection of buildings with the greatest potential for energy conservation.** Baird, G.; Brander, W.D.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

New Zealand, in common with most developed countries, has been forced to reappraise its energy supply and demand situation. Systematic studies of the various demand sectors have been carried out during the last decade. The Energy Research Group at Victoria University's School of Architecture has conducted several surveys of energy demand in the building sector. The group is now carryig out detailed studies of the energy end-use patterns of commercial buildings, the energy performance of schools, and the energy management of government buildings. The work has led to the development of several techniques related to building energy management. Possibly the most important of these techniques - how to select, from a group of buildings, those with the greatest energy conservation potential is described here.

24823 (DOE/CE/40596—T1, pp 61-63) **New engineering design approach to building energy conservation.** Stenhouse, D.S.; Leonov, A. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Various strategies have been promoted for conservation of energy in the building, industry, and transportation sectors. Emerging energy sources and the subjects of actual and embodied energy are reviewed. The merits of design and selection of materials and equipment based on the energy required for their manufacture, delivery, and installation are discussed. A system of embodied energy indices which can be used to compare existing and/or new building equipment and materials is proposed. In this respect, it is recommended that priority be given to those items that are mass-produced. It is concluded that this will result in substantial energy savings since the specification of various materials and equipment in a building (and the effect this has on embodied energy) has a far greater impact on energy use and on the health of our economy than merely the regulation of actual energy required to operate a building. Establishing reasonable limits on building energy use that include both actual and embodied energy is seen as a more comprehensive approach to the energy problem and one which more properly recognizes the relationships between the building, industry, and transportation sectors. It is also proposed as a more meaningful technique by which design professionals can make legitimate decision-making tradeoffs in the total building project delivery process.

24824 (DOE/CE/40596—T1, pp 69-75) **Influence of two-position control dynamics on energy utilization in buildings.** Mehta, D.P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Building envelopes, heating, ventilating and air-conditioning (HVAC) systems and building occupants interact with each other and with the exterior environments on a dynamic basis. The interactions result in a complex energy transfer between interior and exterior environments. Envelope and environmental control system dynamics have a significant influence on the energy required for comfort. The objective of the research reported to study the relationship between the thermostat differential, part load operation, furnace over-capacity, cycling pattern, energy consumption and occupant's thermal acceptability in a combustion-type heating system with two-position control. An analytical model was developed and applied to derive the relationships. An analysis of the relationships led to the formulation of new thermal control strategies for reducing energy consumption in buildings. It has been concluded that these energy saving strategies do not produce conditions of discomfort.

24825 (DOE/CE/40596—T1, pp 83-88) **Reducing energy costs of cooling systems with ice storage.** Marquette, C.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Two types of thermal storage systems that will provide chilled water for storage are described: chilled water storage and ice storage. Three types of partial ice storage systems are discussed: the ice storage/refrigerant coil system; the ice storage/parallel evaporator system; and the compressor-aided storage system. The economics and advantages of ice storage systems are presented. (MHR)

24826 (DOE/CE/40596—T1, pp 89-96) **Heat pump strategies and payoffs.** Gilbert, J.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Some simple formulas are presented for the design and economics of heat pump systems so that the reader may easily determine which heat pump applications are most cost effective. Commerically available equipment is considered to determine the near-term and future economic viability of each approach as a function of the source and user temperatures, and magnitude of heat flow. Generic heat pumps, including vapor recompression designs are explained, costed, estimated in performance, and evaluated as a function of basic economic parameters such as local utility and fuel rates. Steam recompression and generaion of steam from moist, hot air are also investigated specifically.

24827 (DOE/CE/40596—T1, pp 97-102) **Variable-air-volume system for Phoenix City Hall.** Teji, D.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

In most old City-owned buildings, heating and cooling is accomplished by varying the temperature of a constant voluem of supply air. In a variable air volume system a smaller total quantity of air is directed to the zones in proportion to the varying loads throughout the day. Since air distribution energy forms a substantial percentage of the total energy required for heating and air conditioning, a variable air volume system can save a considerable amount of energy. The Variable Air Volume System conversion for the Municipal Building (City Hall) for the City of Phoenix is desribed. This building was originally constructed with a dual duct, hot and cold, system using constant air volume with variable temperature for cooling and heating the building. Four supply air fans and two return air fans with a total of 340 horsepower installed capacity provided air circulation through the building. The purpose of this project was to to retrofit the City Hall with a variable air volume system and quantify the amount of energy and cost savings. A computer analysis which was done on the building indicated that it was possible to significantly reduce the volume of supply air. This was accomplished by turning off two out of four supply air fans and both return air fans. Further reduction was made possible by implementing the variable air volume system. Preliminary results indicated an average of 50% reduction in the energy consumption of the remaining two fans was possible over the useful life of the equipment.

24828 (DOE/CE/40596—T1, pp 103-109) **Energy conservation by design.** Cooper, D.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Design considerations for energy conservation are discussed including the following: vapor barrier location, double vs single glazing, boxed soffits, and attic ventilation. The mechanical considerations include: dedicated pumps in parallel, parallel pump curves, three-way valve characteristics, and heat recovery systems. (MHR)

24829 (DOE/CE/40596—T1, pp 111-117) **Energy efficient control of common variable volume systems for the sun belt.** Gould, B.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Variable volume systems have over a period of the past five years gained relatively universal acceptance as being the most energy efficient system for a wide range of types of building mechanical systems. The most common application has been that of commercial office building space although other facilities such as

schools, public areas of hospitals, and research labs are also applying the variable volume principles. While the development of variable volume is largely due to a search for more energy efficient systems it also provides additional zoning, versatility for modification and flexibility for on/off cycling that may not be easily obtainable in other types of systems. Much experience has been gained in the south and western parts of the country on variable volume systems and it is a review of current control techniques that is covered here.

24830 (DOE/CE/40596—T1, pp 119-122) **Heat pump utilizing ground water as heat source.** Kardan, C. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Ground or well water is discussed specifically as a heat source for existing air conditioning equipment (refrigeration) to supply heat during the winter. The principles are described and the availability of ground water is discussed. The economics of the water source heat pump is discussed vs the air source heat pump, electric resistance heat, natural gas, and oil heating. (MHR)

24831 (DOE/CE/40596—T1, pp 153-158) **$500,000/Year: energy management successes in the convenience store and snack food business.** Johnston, W.E.; Kraemer, T.C. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Energy management methods are described and estimated energy savings are projected for 450 convenience stores and 135 pretzel stores. Results from some test stores are shown. (MHR)

24832 (DOE/CE/40596—T1, pp 223-229) **Design of a heat pump and storage air conditioning system.** Elms, L.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Experience with school libraries which have intensive use as central resource centers has shown that natural and mechanical ventilation is inadequate to maintain a pleasant learning environment. Studies showed that the nature of the heating and cooling loads was such that heat pumping and thermal storage principles, while providing desirable features of energy conservation would also reduce the maximum power requirement. The system described provides heating and cooling from a water chiller and thermal storage tank through an existing air handling unit. When required, morning theating is provided by circulating condenser water through a wide range coil while storing he chilled water in the tank for use in the afternoon during which cooling will be needed. For summer, cooling is provided by the combined operation of the water chiller and the water storage as necessary. The functions of the equipment and controls is described for the various operating modes of the system. Estimates of energy consumption are presented which illustrates that the use of precious oil fuel for heating is not necessary and that the cost of the energy could be reduced while providing comfort and a satisfactory learnig environment for the whole school year.

24833 (DOE/CE/40596—T1, pp 281-289) **Development of generic design guidelines for condensing heat exchangers for residential furnaces and commercial boilers.** Lux, J.J. Jr.; Fischer, R.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Both analytical and experiemntal results of an initial investigation into the development of generic design procedures that may be used in designing condensing heat exchangers are presented. During this study, research was conducted to determine the current state of knowledge of heat-transfer with condensing vapors in the presence of a noncondensible gas, typical of conditions found in a furnace flue. Based on this research, an analytical design procedure was developed and adapted to selected heat exchanger geometries typical of those that would be considered for use in a residential condensing furnace. Experimental heat exchangers were then designed, constructed, and tested in the laboratory using flue gas from a commercially available oil-fired furnace. The laboratory experiments were designed to provide information that could be used to refine and validate the analytical design procedure.

24834 (DOE/CE/40596—T1, pp 295-297) **Energy conservation with radiant tube systems.** White, R.B. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The design, advantages, and uses of Radiant Tube Systems are described. The Radiant Tube Systems potential for heat recovery is emphasized. (MHR)

24835 (DOE/CE/40596—T1, pp 333-338) **IES illuminance recommendations and UPD lighting power budget procedures.** Fisher, W.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Illuminance categories and illuminance values for generic types of activities in interiors and weighting factors to be considred in selecting specific illuminance within ranges of values for each category are presented. A procedure for computing a lighting power budget is outlined and discussed. (MHR)

24836 (DOE/CE/40596—T1, pp 339-344) **Lighting control: applications and directions.** Farnham, C.P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The types of lighting controls are reviewed and an analysis of their effectiveness is presented. (MHR)

24837 (DOE/CE/40596—T1, pp 347-351) **Cost effective energy strategy for new housing.** LaRue, M. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The optimization procedure compares the value of the savings resulting from a contemplated improvement with the cost of that improvement. The present value of future savings, the decision method, the thermal design procedure, annual winter solar gains, optimizing the structure shell conductive elements, infiltration, air conditioning, and the performance of the structure are discussed. (MHR)

24838 (DOE/CE/40596—T1, pp 353-358) **Mass-save: an aggressive approach to regulated RCS programs.** Parisi, D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Each electric and gas utility company that is covered by Title II of the National Energy Conservation Policy Act (NECPA) of 1978 has had to face the issue of how to meet NECPA's mandates. Mass-Save, Inc. was formed as an aggressive response to both NECPA and a state law, Massachusetts C. 465, by the state's covered utilities. The aggressive approach has resulted in a highly successful visible program which can perhaps provide substantial benefits to the member utilities in addition to the conservation actions effected by the program. This paper is a description of Mass-Save as it functions in a complex organizational and regulatory climate, as well as a description of some of its special programs that are manifestations of its aggressive approach to performing a residential conservation service (RCS) program.

24839 (DOE/CE/40596—T1, pp 359-365) **RCS audit for a hand-held programmable calculator.** Beanland, M.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

An RCS Class A residential energy audit methodoloy has been designed, developed, and implemented by the City of Palo Alto Utilities Department and Northern California Power Agency member utilities. The methodology is designed for use on hand-held programmable calculators. The Palo Alto version has been accepted by the Department of Energy (DOE) and the California Energy Commission (CEC). The method's low cost of implementation and its flexibility are ideal for a small municipal utility or community based organization. The procedure comprises a repertoire of programs that can be used in almost any sequence or by-passed if not applicable. The procedure provides the homeowner with accurate information about energy and cost savings. The repertoire structure allows for easy updating of program as parameters change or analysis techniques improve.

24840 (DOE/CE/40596—T1, pp 369-370) **Approach to financing energy conservation projects at Johnson & Johnson Products, Inc.** Pearson, H. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

At Johnson & Johnson, with energy cost escalation considered, management will support projects with an 8 year payback. The goal is to reduce energy 20% or more in our world wide opeations and some of our plants have achieved that goal.

24841 (DOE/CE/40596—T1, pp 371-373) **Determination of an energy baseline and adjustments for a shared savings financing program.** Castonguay, M.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Many energy financing projects utilize an energy baseline approach for allocating future shared savings. Establishment of a reasonably accurate baseline value, as well as various other adjustment factors, is crucial for both parties in the financing program. This paper details the process utilized in baselining heating energy requirements for a 300,000 sq. ft. plastics manufacturer. The information presented is instructive for any general energy baselining approach, but is particularly useful for analysis of buildings with substantial internal heat gains. The paper discusses these key factors: analyzing historical energy data; calculating normalized energy usage; establishing the energy baseline; and predicting adjustment factors for variations in weather.

24842 (DOE/CE/40596—T1, pp 407-411) **Improving energy productivity through better building operations.** Swetish, J.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The energy conservation efforts associated with offices and other commercial buildings within Deere & Company are summarized. Concepts such as variable air volume HVAC systems, task ambient lighting, energy efficient lighting modifications, computerized energy management systems, etc. are reviewed and examples presented. Deere & Company's first venture into large scale solar heating for a commercial building is described in detail. The process of establishing an energy management program for the marketing and product distribution branch houses is discussed, together with the necessity of performing an energy audit and of measuring results. The quantitative results of the Deere & Company energy conservation program are presented.

24843 (DOE/CE/40596—T1, pp 413-416) **Improving energy productivity through building simulation.** Henry, W.E. Jr. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Approximately 500 million square feet of new and renovated commercial space will be added to the nation's building stock annually. Much of this space will be designed by architects and engineers. Many decisions in the design process will affect building energy use; the evaluation of these decisions and the understanding of their interaction is not intuitive. Computer energy simulation of buildings will allow the designer to evaluate the maximum number of variables. The most energy efficient building which meets all requirements will result from the process.

24844 (DOE/CE/40596—T1, pp 483-488) **Energy savings computations for control by energy management system.** Fowler, D.M. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The energy savings computations discussed here were done for a 49 floor all-electric high rise office building of 1.4 million gross square feet in downtown Dallas. The building exterior consists of double pane reflective glass, 37% of which is vision glass. The cooling system includes two 1520 ton chillers and one 760 ton chiller, serving variable air volume air handlers every other floor. Heating is by means of resistance duct heaters and fan powered mixing boxes with electric heating coils downstream. The owner, a major developer, needed assistance in deciding whether or not to install an energy management system (EMS). They also wanted assistance in deciding which loads were economical to control if they decided to install an EMS. As is normally the case for a new building, the basic building design was essentially complete when these studies were started. For each separate computation below, the local controls as provided in the initial design documents and specifications are outlined, followed by a brief discussion and the EMS energy savings calculations. Before this energy savings study was undertaken, a computer building simulation study has been completed for the purpose of establishing the design energy budget or goal. This earlier study is referred to from time to time.

24845 (DOE/CE/40596—T1, pp 489-491) **Automated integrated data (AID) concept.** Gifford, N.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Today's modern large-scale or high-rise building contains various control and monitoring packages which are associated with the building's systems such as elevators, life-safety, and HVAC. Although the trend has been toward greater sophistication in technology for the various systems, it has only been through the advent of the Division 17 Specification that there has been an attempt to integrate some of these elements. This paper addresses the need for the integration of these systems but not in the traditional manner which has been attempted to date. Due to the greater intelligence associated with each individual control and monitoring system, the alternative to having a single computer responsible for the various building elements is to create an Automated Integrated Data (AID) Center which can be utilized by all the departments responsible for each building system. The goals of the AID concept are to: establish a common technology level for all hardware and software for the building's systems; provide a communications network for all these systems; and implement an operational concept which can reduce costs, improve efficiency, and address the building as a complete entity for any given situation.

24846 (DOE/CE/40596—T1, pp 493-496) **Improving HVAC service through remote monitoring of energy management systems.** Kettler, J.P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

There are basically four levels of energy management systems: (1) time clocks; (2) duty cycling and demand limiting devices; (3) combinations of 1 and 2, plus remote analog read and reset capability; (4) combination of 1, 2, and 3, plus system color graphics and computer algorithms for chiller/boiler optimization, etc. This paper is not going to go into the individual payback periods and energy saving comparison of the various EMS products because this varies from system to system. Rather, it is intended to emphasize the benefits remote monitoring can offer in addition to start-

stop, load shedding, etc., functions that most energy management systems provide. These benefits being the potential to reduce service costs, increase tenant satisfaction, provide more effective troubleshooting and reduce a contractor's risk in providing full service contracts.

24847 **(DOE/CS/20271—4) Design and operational energy studies in a new high-rise office building. Volume 4. Building automation analysis.** (Tishman Research Corp., New York (USA)). Mar 1984. Contract AC02-79CS20271. 199p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010687.

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The objectives of the analysis are to evaluate the application of a number of building automation system capabilities using the Park Plaza Building as a case study. The study looks at the energy and cost effectiveness of some energy management strategies of the building automation system as well as some energy management strategies that are not currently a part of the building automation system. The strategies are also evaluated in terms of their reliability and usefulness in this building.

24848 **(DOE/CS/20271—5) Design and operational energy studies in a new high-rise office building. Volume 5. DOE-2: comparison with measured data.** (Tishman Research Corp., New York (USA)). Mar 1984. Contract AC02-79CS20271. 130p. NTIS MF A01; 2; GPO Dep. Order Number DE84010570.

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The purpose of the DOE-2 comparison study is to compare the energy consumption for the Park Plaza building predicted by the DOE-2.1 simulation with actual energy consumption measured by the data collection system at the building. The extensive and detailed output of the data collection system provides a basis for verifying the accuracy of DOE-2.1 at a component level over short intervals of time in each of the four seasons.

24849 **(DOE/CS/20315—T16) Technical support document. Energy use projections for the four products.** Statt, T.G.; Leonard, F.W.; Coggins, J.L. (Energy Applications, Columbia, MD (USA)). Nov 1983. Contract AC01-79CS20315. 116p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84010737.

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This report summarizes an investigation conducted for determining whether energy efficiency standards for four consumer products would result in significant conservation of energy. The products are dishwashers, television sets, clothes washers, and humidifiers and dehumidifiers. Energy savings attributable to trial standard levels were estimated by the Energy Use Projection Model, developed especially for this investigation. Trial standard levels represent the minimum value of energy efficiency which each unit of a covered product must meet or exceed in order to be in compliance with a hypothetical energy efficiency standard. Sensitivity analyses were conducted based on changes in market behavior and in trial standard levels. Energy savings were compared to the three tests of significant conservation of energy used in the eight products standards analysis. One major conclusion is that standards for the four products would probably not result in significant conservation of energy. Another conclusion is that the 1988 sales-weighted energy efficiency is likely to be greater than or equal to the energy efficiency at the minimum life-cycle cost point. Standard could result in increased life-cycle costs for the four products.

24850 **(DOE/R7/01209—T1) Automatic heating/cooling energy distribution system. Final technical report.** (Fedde (Chris D.), Cedar Rapids, IA (USA)). 14 Mar 1983. Contract FG47-81R701209. 12p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010099.

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This project consisted of developing and installing a computerized heating and cooling air distribution system. The features of the system are as follows: (1) reduced temperature variation because of a constant flow of energy and more precise temperature control. This characteristic allows the facility to be operated at a lower temperature in winter and a higher temperature in the summer with the same creature comfort because the occupants are not being exposed to constant temperature variations or bursts of heating or cooling air. (2) Ability to reduce the energy required by any room for any period of time when the room is unoccupied or the activity in the room doesn't require the same temperature as other parts of the facility. The description of the system in this report assumes the logic consistent with winter heating requirements. An interpretation of summer cooling operation could be developed by substituting air-conditions on-time for furnace burn-time in the discussion.

24851 **(DOE/R7/01241—T1) Improvement of heat pump performance using multicomponent refrigerants. Final report.** Mathiprakasam, B. (Midwest Research Inst., Kansas City, MO (USA)). 30 Jul 1982. Contract FG47-81R701241. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010454.

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The possibility of improving the performance of heat pumps by using binary mixtures of refrigerants was evaluated. The program consisted of two major activities: (1) identification of a number of refrigerants that are suitable for heat pump opertion, collecting the thermodynamic properties of these refrigerants, and converting these data to suitable forms for preparing computer codes and calculating the thermodynamic properties of suitable binary mixtures formed by the refrigerants chosen; and (2) the formulation of an ideal heat pump cycle similar to the well-known vapor compression refrigeration cycle, using binary mixtures as working fluids, the determination of the coefficient of performance of the new cycle, and comparison of the results with those of conventional cycles using single-component refrigerants. For the heat pump operation, R-12 was chosen as the main component in the binary mixture. Two compatible refrigerants, R-11 and R-114, were chosen as secondary components to be mixed with the main component. Vapor compression cycles using the binary mixtures of refrigerants were formulated and analyzed. A computer program was prepared to determine the Coefficient of Performance (COP) of this cycle and several runs made. The results indicate that an improvement in COP of 15 to 20% is achievable if multicomponent refrigerants are used in heat pumps.

24852 **(DOE/R7/01247—T1) Coleman Highlands subsurface air utilization study. Final report.** Shapiro, M.D. (PBNA Architects, Inc., Kansas City, MO (USA)). 15 Nov 1982. Contract FG47-81R701247. 31p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010433.

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An investigation was conducted into the feasibility of using a 1 million square foot developed cave within the Downtown Industrial Park as a heating and cooling source for a proposed residential subdivision on an adjacent vacant tract of land. Both sites are located near the Coleman Highlands neighborhood in the Westport Community of Kansas City, Missouri. Characteristics of the cave and surface sites were studied, as well as potential heating and cooling sources and transfer media. BTU capacity of the cave and demand for the prototype houses was calculated. The preferred system included a water source in the cave, water transfer medium, and water-to-air heat pumps in the individual homes. Analysis of that system showed it would be marginally effective due to the limited heat valve available in the cave and substantial shortfalls of cooling capacity for summertime operation. Estimated system costs appeared to be in an affordable range, but it was felt that those capital costs could be better applied to other energy-conserving measures.

24853 **Earth-sheltered building research facility at Ames Laboratory.** Szydlowski, R.F. (Iowa State Univ., Ames). pp 185-192 of Earth shelter performance & evaluation proceedings. Boyer, L.L. (ed.). Stillwater, OK; Oklahoma State University (1983). (CONF-811034—). Contract W-7405-ENG-82.

From 2. national technical conference on earth sheltered buildings; Tulsa, OK, USA (16 Oct 1981).

Verification of an earth-sheltered building heat transfer model is essential for its widespread acceptance and use during building design. An earth-sheltered building research facility has been design and constructed at Ames Laboratory, Ames, Iowa, to provide experimental data under controlled conditions for checking model accuracy. The earth-sheltered components of the research facility are thoroughly instrumented in order to monitor both detailed heat transfer characteristics and overall building performance. The building design and construction, instrumentation, and research objectives are discussed. 4 references, 4 figures.

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24854 (ANL/CNSV—44) **Energy and materials recovery from industrial wastewaters.** Kremer, F.; Broomfield, B.; Fradkin, L. (Argonne National Lab., IL (USA)). Nov 1983. Contract W-31-109-ENG-38. 263p. NTIS, PC A12/MF A01; GPO Dep. Order Number DE84010345.

The objectives of this study were to identify the larger industries generating wastewaters and to define the properties of their respective effluents, particularly those constituents presenting problems in meeting effluent standards. These constituents were examined to determine their potential for conversion to energy. The following industries were investigated: electroplating, iron and steel, textile, petroleum refining, pulp and paper, food processing, and organic chemical.

24855 (ANL/CNSV-TM—129) **Energy-conserving technologies for industry: a summary of recent progress in research and development.** Monarch, M.; Alston, T.; Macal, K.; Macal, C.; Tatar, J.; Hersh, H.; Blomquist, C.; Singh, M.; Larsen, R. (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 187p. NTIS, PC A09/MF A01;. 1; GPO Dep. Order Number DE84010492.

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Fifty-six summary sheets on energy-conserving industrial technologies were prepared. These summaries describe Office of Industrial Programs (OIP) energy-conservation and waste-recovery projects that have progressed to the point of potential industrial application. Possibilities for cross-industry applications are pointed out in many of the summary sheets. Each summary includes the following types of information: industrial application, process energy savings, conventional situation, new technology, R and D project development and status, technical information, economic analysis, and industry-wide savings.

24856 (CONF-8204112—2) **New industrial park energy supply for economical energy conservation.** Scott, D.; Marda, R.S.; Hodson, J.S.; Williams, M. (Oak Ridge National Lab., TN (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA); Gulf States Utilities Co., Beaumont, TX (USA)). 1982. Contract AC05-84OR21400. 9p. NTIS, PC A02; 3; GPO Dep. Order Number DE84007404.

From 4. annual industrial energy conservation technology conference; Houston, TX, USA (6 Apr 1982).

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The new industrial park energy supply (NIPES) concept is an attractive approach for providing a stable, long-term domestic energy source for industrial plants at reasonable cost and reasonable financial risk. The NIPES concept consists of a system of energy supply stations and steam transmission lines that supply process heat and electricity to multiple users in an industrial park(s) setting. The energy supply stations grow along with the industrial park(s) as new industries are attracted by a reliable, reasonably priced energy source. This paper describes the generic NIPES concept and summarizes the results of the evaluation of a specific NIPES system for the Lake Charles, Louisiana, area. The economics of the specific NIPES system is compared to that of individual user-owned coal-fired facilities for new industrial plants and of individual user-owned oil-fired facilities for existing industrial plants.

24857 (DOE/CE/40596—T1, pp 5-9) **Boiler efficiency improvement projects resulting from engineering audits.** Feledy, C.F. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

This case study has demonstraed that the use of well-qualified engineering consultants to conduct audits of boiler performance is a very cost-effective way to reduce fuel costs and improve corporate profitability. Thus, it is recommended that boiler audits be included as one of the major elements in a corporate conservation program for those companies having significant boiler facilities.

24858 (DOE/CE/40596—T1, pp 11-19) **Improving seasonal efficiency of commercial gas fired heating boilers.** Cairns, J.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The effectiveness of a boiler retrofit procedure designed to improved the efficiency of gas fired heating boilers is evaluated. The procedure is shown to produce significant improvement in seasonal efficiency by increasing combustion efficiency in the burner on-cycle and by decreasing standby losses in the burner off-cycle. The major causes of energy loss in gas fired heating boilers - excess combustion air and convective flue losses - are described. Typical values of on-period and off-period losses are given for commercial heating boilers. The installation procedure for a unique retrofit is described, including the method of determining the optimum volume of excess combustion air. Experimental data are given from field measurements after retrofit which show the increase achieved in steady state combustion efficiency, and the decrease in off-period flue losses. The pre- and post-retrofit data are used in a simulation developed by the National Bureau of Standards for estimating the seasonal performance of heating systems. This simulation procedure involves: (1) measuring flue gas temperature and O_2 concentration during steady-state boiler operation; (2) obtaining information on the shape of the flue gas temperature-time curves as the appliance heats up and cools down; (3) assigning appropriate values to various factors which describe the off-cycle air flow rate through the flue and stack, the degree of boiler oversizing, and the effect of boiler operation on infiltration; and (4) carrying out a calculation procedure which predicts the seasonal efficiency.

24859 (DOE/CE/40596—T1, pp 21-25) **Industrial boiler designed for wood waste and agricultual residual fuel.** Brown, M.; Bulpitt, W.; Harris, D.E. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Utilization of low cost abundant fuels can vastly improve the operating economy of an industrial boiler. This paper describes a boiler installed by a large agricultural cooperative capable of operation on wood waste and agriculture residue fuels. A flexible design able to use wood and agricultural residue in any combination in addition to gas, oil, or coal was developed. The system has proven capable of meeting plant steam demand and state emission regulations on all fuel combinations. Information on boiler operation, maintenance, and economics is included. The experienced gained from the design and operation of this system is applicable to many other similar situations.

24860 (DOE/CE/40596—T1, pp 29-33) **Energy: a buyer's guide.** Sherry, E.V. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The role of the federal government in incentives for energy conservation in the industrial sector is discussed. Other topics covered are: factions of the past decade; energy factions; conflicting interests and aspirations; the industrial user's viewpoint; need for gas policy; electric rate trends in the United States; rate trends in Europe; interruptible rates in the UK, France, the Common

Market, and the United States; internal arbitrage; the responsibility of industry; and the economy. (MHR)

24861 (DOE/CE/40596—T1, pp 65-67) **Electrical demand control - an essential ingredient for complete energy management.** Goetz, D.F. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The following are discussed: conservation and load management; demand measurement; demand profiles; and practical demand analysis system. (MHR)

24862 (DOE/CE/40596—T1, pp 79-81) **Industrial boiler room ventilation.** Chandrashekar, S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The Medical Area Total Energy Plant is located in Boston. The following are described: conventional systems energy saving system; design; ventilation; heating; electric power input; and noise. The boiler plant ventilation system can be effectively designed to reduce the energy consumption without sacrificing the performance and operation of the plant. In this case, the simple payback period was within two years, despite the constraints that were imposed concerning location, noise and staggered construction schedule.

24863 (DOE/CE/40596—T1, pp 125-128) **Cogeneration in a commercial environment: paper incineration with heat recovery, electricity, space heating and cooling.** Gagliardi, R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Besides rising energy costs, Ford Aerospace and Communications Corporation, Western Development Laboratories Division, faces the added problems of the destruction of classified and proprietary documents, and diminishing municipal sanitary landfill areas. A single solution to these immediate problems has been found in a planned incineration system with waste heat recovery and cogeneration. The incineration system will dispose of 10,000 lbs. of paper waste daily including approved destruction of classified and proprietary material. The exhaust gas from the incinerator will produce steam from a waste heat boiler which will in turn drive a steam turbine to generate electricity. The hot water leaving the turbine will be used for space heating and cooling by absorption. The system results in the reduction of gas and electric costs, paper waste disposal costs, and demand on local resources. The estimated cost of the project is $1.3 million and has a projected annual rate of return of 35%. Third party leasing and state financed bonds are being actively pursued. Future plans include incineration as a service to other businesses in the area and disposal of hazardous materials.

24864 (DOE/CE/40596—T1, pp 129-131) **Mechanical cogeneration in a food plant/warehouse.** Haviland, J.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The system consists of the following components. The mechanical load is a Stahl Screw Compressor on an ammonia refrigeration system. This has a power requirement of 625 bhp at our operating conditions. This machine is designed to operate at 3600 rpm. A Caterpillar G399 engine was chosen as the power source. This unit provides 730 bhp at 1000 rpm, turbocharged and aftercooled. A speed increaser is used to drive the compressor at 3600 rpm. This was done so that the same compressor could be used as we already had in the facility. Two levels of heat recovery are required. The engine jacket cooling water is used to heat domestic hot water through a heat exchanger. A load balance condensor is piped in series with this heat exchanger. This unit has four fans which are cycled based on return water temperature to the engine. This ensures that the proper amount of heat rejection occurs at all times. The engine exhaust goes through a Maxim heat recovery muffler. This unit provides 100 psig steam for process use in the facility. This is not an ideal configuration, but was necessary to match existing conditions.

24865 (DOE/CE/40596—T1, pp 139-146) **Evaluation of industry/utility cooperative efforts in cogeneration.** Limaye, D.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

An approach to estimate the costs and benefits of cogeneration to industry and utilities (and appropriate third parties) is described and alternative institutional arrangements to implement cogeneration are explored. Specific computer models for detailed evaluation of the impacts of cogeneration are described and applications to specific case studies are illustrated.

24866 (DOE/CE/40596—T1, pp 147-150) **SECO-Dow Corning's wood filled industrial cogeneration project.** Rolka, H.; Sworden, P.E. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

In 1979 Dow Corning Corporation decided to use wood as a primary fuel for its new steam and electric cogeneration (SECO) power plant. Cogeneration is the production of both steam and electricity in a single operation. The SECO project underscores Dow Corning's commitment to conservation and alternative energy sources at a time when reducing US dependence on foreign oil is a national priority. This power plant will have multifuel capability, but wood in the form of chips will be the primary fuel. Approximately half of the wood will come from forest land within a 75-mile radius of Midland, Michigan. The remaining wood will come from urban ad rural wood residue. To help accomplish this, Dow Corning has assembled a natural resources team of three foresters, two wildlife biologists, and a field ecologists to plan and carry out sound forest and wildlife management programs.

24867 (DOE/CE/40596—T1, pp 159-161) **Dover textiles: a case history on retrofitting factories with a boiler system fueled on coal, wood and waste.** Pincelli, R.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Coal continues to be, in the Eastern United States, approximately 50% the cost of gas/oil per million Btu's. Several projects are now well documented with respect to conversion to coal, wood and waste fired boiler systems. These projects include Dover Textiles, Shelby, North Carolina, and Continental Grain, Cameron, South Carolina. Projects under construction include Ti-Caro's - Piedmont Processing, Belmont, North Carolina; Cross Cotton, Marion, North Carolina, a second Dover project at Cherryville, North Carolina; (2) Burlington conversions to coal at Erwin and Cordova as well as a non-textile industrial plant, Anchor Continental, Columbia, South Carolina, burning coal, wood and processed tape waste. This case history of Dover Textile, Shelby, North Carolina will document a payback of less than 2-1/2 years and a return on investment of 35%; benefits of North Carolina and Federal investment tax credits; EPA considerations, which in this case required no additional capital investment; fuel supply; material handling; ash removal; and other design considerations.

24868 (DOE/CE/40596—T1, pp 171-174) **Joint energy conservation effort between a utility and a manufacturing plant.** Payne, P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

During 1980, the management at American Valve and Hydrant (AVAH) became increasingly concerned about the rising cost of energy consumption within their plant. AVAH officials sought advice and direction from Gulf States Utilities (GSU) and state agencies involved in industrial energy conservation efforts, and a walk-through survey of the plant was performed by an energy engineer. Although much useful data was obtained during the course of the walk-through, and thereafter by billing histories obtained

from the plant's energy suppliers, there were concerns about the limitations presented by having only one metered point to analyze AVAH's electrical consumption. Efforts to resolve these concens resulted in the development of a joint energy conservation research project involving the utility and the plant. After much deliberation it was agreed upon that GSU would furnish mag-tape metering units at each of the three in-plant locations. A survey meter was located at the machine shop, another at the foundry and a third in the cleaning room. Results are discussed.

24869 (DOE/CE/40596—T1, pp 251-256) **How to evaluate and select a boiler control system.** Trimm, G. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The process of control system selection for a multi-boiler, multi-fuel powerhouse is explored in depth. Individual boiler and total powerhouse optimization are also considered.

24870 (DOE/CE/40596—T1, pp 261-263) **Industrial energy management - looking beyond the plant gate.** Loyless, E.M. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Three points are made: if we are to effectively manage energy costs, we must be concerned with energy prices as well as energy consumption; the current system of regulated energy prices causes industry to pay more than its fair share of the cost of providing energy; industrial energy managers can work to combat the rapid escalation of enegy prices by educating yourself; educating the public; intervening in the regulatory process; and being prepared with alternative energy sources.

24871 (DOE/CE/40596—T1, pp 271-277) **Conservation of energy at Westinghouse R & D.** Norelli, P.; Roy, V. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Presented herein is the history of Conservation of Energy at the Westinghouse R & D Center from the time of the OPEC crisis to the present and forecasts of our intended programs for the next few years. The energy and fuel saved from 1973 to 1977 are credited to the Westinghouse Corporate Task Force recommendations and to our own informal conservation programs. The natural gas shortages of early 1977 and the national coal strike of early 1978 resulted in extreme gas and electric energy savings but not without some loss of comfort and research. More modest savigs are attributed to the computerized Energy Management System consisting of a central Westinghouse 2515 Minicomputer Control Center and five (5) remote NumaLogic Microprocessors - but without loss to comfort or to research. This report also presents an economic analysis of the investment in the current R & D installation of a waste heat recovery system with TEMPLIFIER heat pumps. Some current projects such as a new boiler-burner, dual fueled, with oxygen sensor controller added - and a new insulated glass system piggybacked on existing window panes - are also presented.

24872 (DOE/CE/40596—T1, pp 291-293) **Heat recovery boilers in industry.** Cutler, R.R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The implementation of Heat Recovery Projects in the glass and plastic industry and the results therefrom are outlined. Described herein are the preliminary investigations, application studies, project economics with justification through fuel savings, system description, boiler design, installation and operational experience.

24873 (DOE/CE/40596—T1, pp 299-302) **Pyrolytic incineration of solid waste for energy recovery.** Ollman, P.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Pyrolytic incinerators for the solid wastes of the East Moline Plant of International Harvester are described. The system, its energy recovery, problems, and solutions are discussed. (MHR)

24874 (DOE/CE/40596—T1, pp 303-304) **Kiln waste heat recovery.** Mozzo, M.A. Jr. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The steps used in evaluating and engineering potential heat recovery projects for sanitaryware tunnel kilns are discussed. Also reviewed are case studies of heat recovery projects which have been installed in the plants or were seriously considered by American-Standard for installation.

24875 (DOE/CE/40596—T1, pp 305-313) **Borosilicate glass: its use in waste heat recovery.** Ruston, M.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The properties of low expansion borosilicate glass, its heat transfer coefficient, early uses in heat recovery, and heat recovery system flexibility and performance, and practical aspects and operational experience are presented. (MHR)

24876 (DOE/CE/40596—T1, pp 315-318) **Successful installation of a trash incinerator/waste heat boiler: a case study.** Gallo, A.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

A case history of the successful installation of an incinerator/waste heat boiler in the power house of our Administrative complex in Corning, New York is discussed. Various aspects of the project will be discussed from the early decision factors through a short discussion of potential design/operating problems.

24877 (DOE/CE/40596—T1, pp 323-329) **Low order heat recovery with water source heat pump.** Allen, R.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

This application is a solution to an energy conservation project at the Dworshak Fish Hatchery at Ahsahka, Idaho. The Corps of Engineers and the US Fish and Wild Life Service who maintain and operate the facility became concerned with the rising costs to operate due to excalating cost of fuel oil. There is no natural gas now available there and electrical energy, though plentiful, is becoming more expensive as the grid system mix changes. The hatchery has a need to maintain a constant temperature in the fish rearing ponds which translates into a need for heating during the fall, winter and spring. The facility now uses hot water boilers, both electric and oil-fired, and wastewater heat exchangers as heat sources. The existing Chrysler Air Temp. chillers, can be adapted for use as heat pumps. The heat source will be waste water. Heat will be transferred to the reuse make-up water before mixing with reuse water recirculating back to rearing ponds.

24878 (DOE/CE/40596—T1, pp 377-384) **Industrial steam system optimization.** Viar, W.L. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Industrial steam systems provide unique opportunities for the development of low cost mechanical shaft power. A properly applied backpressure turbine can deliver power to a machine at 40% of the cost of an equivalent motor operating on purchased electricity. Conversely, the cost of power from a turbine exhausting to the atmosphere will be in the order of six times greater than that provided by an efficient motor. Therefore, the relative costs of fuels

and purchased power in your area, coupled with designs of merit and proper operating practice, will determine the success you experience when you power up your steam system.

24879 (DOE/CE/40596—T1, pp 417-423) **Improving energy productivity through better manufacturing processes.** Norian, B.D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Some of the more obscure strategies by which energy and energy dollars can be conserved in industry are addressed here. Although each problem, rationale, and solution described has been successfully implemented in a specific application, the generality of each is such that with perhaps only minor modification, they can be employed in other industries. Some of these strategies are: cover open processes which use heated fluids, cryogenically treat tooling and wear parts for longer life, improve power factor of the plant, recirculate air in the web dryer, alternate loads to reduce demand, minimize roof repair costs with infrared scans, insulate high temperatue equipment, size electric motors to the load, reschedule high-demand processes to the second shift, and verifying improved energy activity. (MHR)

24880 (DOE/CS/40278—T1) **Riegel Textile Corporation, Ware Shoals cogeneration. Final technical report.** (Riegel Textile Corp., Ware Shoals, SC (USA)). 31 Jan 1984. Contract FC01-79CS40278. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008602.

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Riegel signed a cooperative cost sharing agreement with the Department of Energy to design, purchase, install, and operate a new cogeneration system in which a new turbine/generator unit exhausts steam at 225°PSIG. The background of Riegel's previous cogeneration experience is presented; this project is described; and problems experienced in getting the boiler on-line and the turbine/generator up to speed are summarized. The project cost, operating cost, savings, and return on investment are presented. (MHR)

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 24865, 24876

24881 (ANL/CNSV-TM—120-Vol.4) **Thermal systems for conversion of municipal solid waste. Volume 4. Burning refuse-derived fuels in boilers: a technology status report.** Hasselriis, F. (Argonne National Lab., IL (USA)). Mar 1983. Contract W-31-109-ENG-38. 175p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE84010490.

The development and current status of systems for the preparation, combustion, and direct recovery of energy from refuse-derived fuel (RDF) produced from municipal solid waste are described. Facilities that have been operated, are currently operating, or are under construction are reviewed. Problems encountered and solved in the preparation and burning of RDF as a supplementary fuel in existing or dedicated boilers fired with coal and oil (and as the sole fuel in boilers designed for the purpose) are discussed. Relationships between the methods of processing and the design of the combustion and heat-recovery systems are explored, and the design parameters of boilers suitable for RDF burning and their relationship to the fuels are discussed. Economic implications of RDF systems are reviewed. The report also describes research and development efforts to date and identifies research needs.

24882 (ANL/CNSV-TM—133-Vol.1) **District heating and cooling in Provo, Utah. Volume 1. Strategy assessment.** Kron, N.F. Jr.; Reddy, N.; Kennedy, A.S.; Dennis, C.B. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010494.

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Provo, Utah, is one of 28 cities selected by the US Department of Housing and Urban Development to participate in a study of the economic and community-development benefits of implementing a district heating and cooling (DHC) system. A number of DHC options for Provo were studied with the help of the Argonne District Heating Strategy Model. The model was used to analyze demand configuration and supply options. Two economically acceptable DHC systems were recommended for further study in Provo; one is a cogeneration system based on the city's power plant and the other is a noncogeneration system with heat supplied by the heating plant at Brigham Young University, which is located in Provo.

24883 (ANL/CNSV-TM—133-Vol.2) **District heating and cooling in Provo, Utah. Volume 2. Supplemental data for early options studied.** Kron, N.F. Jr.; Reddy, N.; Kennedy, A.S.; Dennis, C.B. (Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010493.

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Provo, Utah, is one of 28 cities selected by the US Department of Housing and Urban Development to participate in a study of the economic and community-development benefits of implementing a district heating and cooling (DHC) system. A number of DHC options for Provo were studied, and the most promising and illustrative of these were described in Volume 1 of this report. This supplemental report provides information on several other options that were under consideration early in the Provo study. These options were subsequently found to be economically poor performers compared to the systems recommended in Volume 1.

24884 (DOE/CE/40596—T1, pp 133-138) **Cogeneration energy systems assessment.** Cummings, C.R.; Sperberg, R.T. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The scope of this study was limited to the consideration of gas-fueled cogeneration system sizes between 100 kW and 10 MW and to applications in the commercial market sector (including multifamily dwellings). The use of natural gas in industrial cogeneration applications is relatively well proven. High utilization of recovered heat, relatively constant operation, and the the relatively low cost of large cogeneration systems combine to provide attractive economics for industrial-sized systems and applications. The proven economic feasibility of these larger systems made it unnecessary to address the industrial market in this initial assessment.

24885 (DOE/CE/40596—T1, pp 177-180) **Demand management: an alternative to new electrical capacity.** Yarosh, M.M.; Stein, D.E. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Load management techniques are described. Utility load management programs and costs and the Florida experience are discussed. (MHR)

24886 (DOE/CE/40596—T1, pp 181-184) **Utilities and industry: partners in power.** Edwards, H.J. Jr. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Problems with the utilities rate structure and financing new generating capacity are described. The idea that the electric utilities and industrial users may cooperate to finance new capacity is explored. The problems of the utility regulators are mentioned. (MHR)

24887 (DOE/CE/40596—T1, pp 185-188) **Implementation of customer directed load management programs in a large investor owned electric utility.** Thompson, R.P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

In recent years, rising electrical energy costs and declining operating reserve margins have caused many utilities to closely examine their corporate commitments to supply their customer electrical energy requirements. Load management programs that are directed towards reducing the usage of electrical energy during the utility's peak generating period are becoming an important part of these utilities' operating plans. Pacific Gas and Electric Company has undertaken an aggressive program to carry out customer directed load management programs in its service territory as a cost-effective alternative to building new generating capacity. This paper will provide an overview of the various load management programs currently being implemented by this large investor-owned combined gas and electric utility.

24888 (DOE/CE/40596—T1, pp 189-198) **Load management: customer options.** Stovall, J.P.; McIntyre, J.M. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340. Contract W-7405-ENG-26.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Load management offers the residential customer an opportunity to reduce energy costs by changing their pattern of electrical energy usage in a way to assist the electric utility to more effectively and efficiently provide electric service. Two customer load management options are discussed. The first option is customer energy storage for space heating and water heating. The benefits or costs of such equipment will depend upon the penetration of installed units, their load characteristic and hours of operation, and the load characteristics of the particular utility. The second option is a residential demand limiter which is being demonstrated by Omaha Public Power District. The demand limiter is set by the customer to the desired level of demand which is related to the expected monthly bill and then controlled by the utility to limit demand when most beneficial to the utility system.

24889 (DOE/CE/40596—T1, pp 201-208) **Fluidized bed boiler: commercial results and practical ground rules.** Ormston, D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Conventional (or vertical) FBC plants are analyzed and four weaknesses inherent within their design are defined. As the result of these weaknesses, and the range of remedial measures necessary to overcome them, the plants built so far have, in the main, departed from the original objectives. The plant equipment and operations have become far more complex, and the FBC's advantage of using low-cost alternatives have been whittled away by extra preparation and running costs. The origins, development, and commercial installation of a simple, proven and thoroughly effective FBC process which overcomes all of the weaknesses apparent in conventional FBCs are presented. This FBC process eliminates the need for excessive fuel preparation, it simplifies FBC operation, and obviates downstream recapture/recirculating chambers. 10 plants have been built in Britain, Japan and Sweden. The most advanced of these is described. It has run continuously since October 1980, producing 6000 to 10,000 PPH steam. Finally, the practical non-theoretical ground rules are given by which to design and operate FBC plants that will work reliably and effieciently.

24890 (DOE/CE/40596—T1, pp 209-212) **Combustion of waste tires for energy recovery.** McFee, J.N.; Vance, R.F.; Apa, R.P. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

A scrap tire fluidized bed combustion system has been demonstrated on a pilot plant scale. The pilot plant tire combustion system was operated using an inert fluidized bed medium for the combustion of scrap tire chunks. wire removal was accomplished by using a continous bed media withdrawal and reinjection system which separated the wire magnetically. Fiberglass melting was avoided by careful system temperature control. Combustion efficiency information led to conclusions on the appropriate fluidizing velocity. Stack sampling methods were used to establish a particulate loading and a particulate size distribution. Sulfur oxide and nitrogen oxide levels were measured and reported. These data were used in designing the off-gas system components. Based on the success of the pilot plant operation, a tire combustion system to produce 1100 Kg/h of steam was designed and is curently under construction. The general flow scheme includes a tire chopper, a fluidized bed combustor with a magnetic wire separator, a cyclone, a heat recovery boiler, and a baghouse. The specified off-gas processing components will lead to a stack gas which meets applicable regulations.

24891 (DOE/CE/40596—T1, pp 215-222) **Optimal design of water distribution networks for district heating.** Caratti, G.; Martelli, F.; Miconi, D. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

A computer aided procedure directed at finding out the minimum cost design of a branched network for district heating systems is presented. A detailed description of the cost-function to be minimized is given. The features of the numerical procedure are illustrated. The results of an application are then reported and analyzed.

24892 (DOE/CE/40596—T1, pp 319-322) **Waste to energy: strategies and payoffs.** Gilbert, J.S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Boiler and engine-based systems, their performance, operating advantages and disadvantages, and the economic performance of each of the major hardware alternatives are addressed. This formulation and decision process for actual waste-to-energy projects is examined with sample energy and economic examples. These guidelines should assist the energy manager in deciding between waste-fired cogeneration or conversion of the powerhouse to alternative fuels.

24893 (DOE/CE/40596—T1, pp 385-389) **Application of energy conservation technology to steam based central plants.** Kilbert, C.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Central Plants lend themselves well to a number of energy conservation measures, some of which have been described. Knowledge of component and system efficiencies is critical to the ability to operate the plant at least cost. A number of optimization techniques have been described which are readily adaptable for solving the boiler-chiller system of cost functions. In cases where the Central Plant has high pressure and low pressure uses a coqeneration turbine may be appropriate for obtaining useful work at the point where throttling normally occurs. Pumping modifications to improve system performance are appropriate in cases where the pumps and system are not well matched due to expansion of the building area which the Central Plant serves. Economizers are appropriate in cases where there is a high flue gas stack temperature with a geometry appropriate for installation of a heat exchanger.

24894 (DOE/CE/40596—T1, pp 427-429) **Short run alternatives to current electric utility fuels.** Westcott, W.W.; Merat, F.L. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

Some of the more promising electric fuel alternatives are covered including: burning of municipal wastes; peat; generation from hot-dry-rocks systems; and pumped storage installations.

24895 (DOE/CE/40596—T1, pp 451-457) **Energy management.** Trieste, R.J. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

This is the program developed at the Brooklyn Union Gas Company. It accounts for 100% of the energy used internally by

the corporation and its primary purpose is to put Brooklyn Union on an energy diet. At Brooklyn Union, all of the energies consumed are utilized in five areas which comprise buildings, gate stations, holder stations, the fleet and the plants. The energies used in these areas are electricity, natural gas, naphtha, methanol, gasoline, diesel fuel, fuel oil, and two additional energy related materials, nitrogen and water. The annual cost of these nine items was almost five million dollars in the 1981 operating year. Four programs make up Brooklyn Union Energy Management System. These being a Statistical Analysis Program, a Recommendation Program, an Awareness Program and a Reporting Program. Each of these programs is discussed.

24896 **(DOE/R7/01233—T1) Jennings Area Recycling Program. Final technical report.** (Jennings, City of, MO (USA)). 8 Nov 1982. Contract FG47-81R701233. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010453.

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A program for collecting the following items from the curb is described: aluminum cans, bi-metal cans, clear glass bottles, colored glass bottles, and newspapers. The amount of materials recycled and the revenues raised are listed.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 24838

24897 (DOE/CE/40596—T1, pp 459-462) **Motivation model for corporate energy conservation.** Janicke, L.A. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The need for a motivation program and selling top management are discussed. The elements necessary for a formal written program plan are listed and described. The contents for a typical energy conservation incentive program are outlined. (MHR)

24898 **(DOE/FE/60173—2) EXTENSION: Energy Plant Process Operations Curriculum Development Project. Final technical report.** Guenthner, R. (North Dakota State Board for Vocational Education, Bismarck (USA)). Spr 1984. Contract FG02-82FE60173. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008847.

The process plant curriculum was evaluated. The project for energy plant process operations curriculum development was conducted and a postsecondary vocational program was implemented. Forty-four students have graduated from the program and 48 are currently enrolled.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 24761

3301 Internal Combustion Engines

24899 **(DOE/CS/50028—1) Performance and emissions characteristics of alternative fuels in spark ignition engines.** Swain, M.R.; Maxwell, R.L.; Swain, M.N.; Bedsworth, K.; Adt, R.R. Jr.; Pappas, J.M. (SRI International, Menlo Park, CA (USA). Materials Research Lab.; Hawthorne Research and Testing, Inc., Miami, FL (USA)). Jan 1984. Contract AS05-80CS50028. 181p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010630.

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A formal ongoing program to characterize the performance and exhaust characteristics of automotive-type powerplants fueled by conventional and alternative fuels is reported. This report contains the information obtained during the past three years when four alternative fuels and two baseline fuels were evaluated in three engines. The four alternative fuels were a simulated gasoline made to represent coal derived gasoline, methyl aryl ethers blended at the 10% level in an unleaded gasoline, gasoline made from methanol, and a blend of Indolene plus methanol and higher alcohols. The two baseline fuels were, Indolene and Gulf unleaded regular gasoline. The engines tested were a pre-mixed carbureted SI (spark ignition) engine, a carbureted three-valve stratified-charge SI engine and a pre-mixed carbureted SI engine with a closed-loop three-way catalyst emission control system.

24900 **(UCRL—90577) Modeling chemical kinetic aspects of engine knock.** Pitz, W.J.; Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1984. Contract W-7405-ENG-48. 25p. (CONF-8404104—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009874.

From Spring meeting of the Combustion Institute; Boulder, CO, USA (2 Apr 1984).

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A chemical kinetics oxidation mechanism for n-butane is employed to study hydrocarbon autoignition related to engine knock. A low temperature submechanism has been added to a previously developed high temperature mechanism in order to examine the importance of low temperature reaction paths in autoignition. A series of calculations follows reactions taking place in a sample of end-gas that is subjected to the pressure and temperature history observed in an actual engine. Predicted autoignition times compare very well those experimentally measured by Smith et al. (1984). However, inclusion of a low temperature submechanism did not affect the predicted autoignition times. Controlling chemical reaction paths are identified. Autoignition was found to be particularly sensitive to reactions involving the production and consumption of HO_2.

3304 Hybrid Systems

24901 (CONF-830974—, pp 182-183) **Electric hybrid vehicle simulation.** Pasma, D.C. (Eaton Corp., Southfield, MI). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

The simulation of electric hybrid vehicles was performed to determine the most efficient configuration obtainable with near term components. Experimental data was used to model propulsion system components whenever possible. The performance of an existing ac propulsion system was used as a baseline for comparative purposes. Hybrid components which were included in the evaluation were electrically and mechanically driven flywheels, and an elastomeric regenerative braking system.

3305 Flywheel Propulsion

REFER ALSO TO CITATION(S) 24768, 24901

24902 (CONF-830974—, pp 173-181) **Assessment of flywheel system benefits in selected vehicle applications.** Forrest, L.; Lee, W.B. (Aerospace Corp., El Segundo, CA). Sep 1983. NTIS, PC A13/MF A01.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Progress to date is reported on a continuing study for the Department of Eergy on the performance potential of automotive vehicles incorporating energy storage flywheels. The study employs computer simulation techniques to evaluate the utility of the flywheel in several vehicle/mission applications. Analysis results are reported for the case of a four-passenger commuter car with battery/flywheel drive-train and a six-passenger family car with heat engine/flywheel drivetrain. System benefits are reported in terms of range enhancement or fuel economy improvement, as appropriate. Effects or influences identified and characterized include flywheel design, vehicle duty cycle, accessory load, trip distance, drive-train arrangement, and road maneuver performance specifications.

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 24744, 25044, 25045, 25046, 25047, 25048, 25049, 25142

24903 (CONF-840664—2) Application of transverse-section analytical electron microscopy to the study of oxidation of metal alloys. King, W.E.; Peterson, N.L.; Reddy, J.F. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006415.

From 9. international congress on metallic corrosion; Toronto, Canada (3 Jun 1984).

We have applied the transverse section analytical electron microscopy technique to study the so-called reactive-element effect in Fe-Cr-Y alloys. In all alloys that were investigated, Y was precipitated as $Y_2(Fe,Cr)_{17}$. Precipitates that were close to the oxidizing interface were observed to oxidize internally. Internal oxidation of a single $Y_2(Fe,Cr)_{17}$ precipitate leads to formation of a colony of much smaller Y_2O_3 particles. These particles are not incorporated into the scale during oxidation. The Y additions were found to strongly affect the microstructural evolution of the growing oxide scale.

24904 (PNL—4847) Cesium chloride compatibility testing program. Annual report, fiscal year 1983. Bryan, G.H. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010574.

A program was started in FY 1982 to evaluate the compatibility of WESF-produced CsCl with 316L stainless steel under the thermal conditions that would be encountered in a geologic repository. The major part of the program involves compatibility testing of six standard WESF CsCl capsules at a maximum CsCl/metal interface temperature of 450°C. The capsules are allowed to self heat to the test temperature in insulated containers and then held at temperature for 2200 to 32,000 h. After thermal aging, the capsules are destructively examined to determine the extent of the metal attack by the CsCl. This report describes the test procedure and summarizes the results obtained during the second year of the program. Metallographic examination was completed of the two zero-time capsules. The photomicrographs obtained of the metal samples indicate the maximum metal attack resulting from the capsule-filling operation was about 25 μm. Metallographic examination of the WESF CsCl capsules held at temperature for 2208 and 4392 h was completed. Both capsules exhibited substantial attack by the CsCl. Maximum attack observed in the 2208-hour capsule was estimated to be about 60 μm, while maximum attack in the 4392-h capsule was estimated at 110 μm. The data indicate the corrosion rate is linear with time for the first 4392 h. When the 4392-h capsule was opened for metallographic examination, it was found that the outer surface of the inner capsule was discolored and pitted at several locations. Metallographic examination of the affected areas showed pits up to 300-μm deep in some areas. The maximum depth observed corresponded to about 9% of the initial capsule wall thickness. No similar pitting conditions observed on the outer surface of the 2208-h inner capsule; but was observed, although apparently to a lesser degree, on the outer surface of the 8784-h inner capsule. 2 references, 31 figures, 5 tables.

24905 (SAND—83-2522C) J-integral testing as a function of rate. Salzbrenner, R.; VanDenAvyle, J.A.; Lutz, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 15p. (CONF-840151—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84008850.

From 39. meeting of IMOG subgroup on environmental testing; St. Petersburg, FL, USA (10 Jan 1984).

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The essentials of J-integral elastic-plastic fracture toughness measurements are reviewed. Extending these methods to higher rates ($K \cong 10^5$ ksi $\sqrt{in/s}$) requires improved measurements of load, load line displacement, and crack length. Two test methods developed here and under contract are presented along with results from tests on ductile cast iron at several rates and temperatures. The ductile to brittle transition temperature (DBTT) for the cast iron alloy increased with test rate, as is typical of ferritic steel alloys. Upper shelf toughness was higher at intermediate rates but decreased at the highest test rate. This work demonstrates two useful J-integral test methodologies to measure high rate fracture toughness.

24906 (UCRL—89774) Analysis of localized microstructural changes in dynamically consolidated metal powders. Gourdin, W.H. (Lawrence Livermore National Lab., CA (USA)). 30 Jan 1984. Contract W-7405-ENG-48. 9p. (CONF-840653—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006298.

From 8. international conference on high energy rate fabrication; San Antonio, TX, USA (17 Jun 1984).

I demonstrate that conceptually simple and quantitatively useful models are available to describe both the localized deposition of shock wave energy during dynamic consolidation of a metal powder, and the accompanying effects on the final compact microstructure. The type and extent of transformation may be estimated, as well as the shock conditions and powder characteristics necessary for optimum consolidation. If the shock history is known, such models can be used to describe different microstructural regions in the final compact. I suggest that the marriage of microstructural models to existing hydrodynamic computer programs could provide a means of making realistic predictions of the type, extent and gross distribution of microstructural changes produced when compaction occurs in complex geometries.

24907 Attenuation and grain noise parameters in Ni-base alloys. Tittmann, B.R.; Ahlberg, L.; Cohen-Tenouji, F.; Quentin, G. (Rockwell International Science Center, Thousand Oaks, CA 91360). pp 129-146 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The frequency dependent ultrasonic attenuation and grain noise were determined for samples of three alloys often used in jet aircraft engine turbine discs: Waspalloy, IN-100, and Ti-6246. In addition to propagation of longitudinal waves, also shear waves were considered. The frequency dependence was extracted from broadband echos received through a low attenuation buffer. A key feature of the results for IN-100 is the presence of a low concentration of micropores which appear to influence the scattering of ultrasound and therefore the attenuation and material noise values. Of the three alloys, Waspalloy was found to have the highest attenuation value and Ti-6246 the lowest.

24908 Computer simulation of probability of detection. Fertig, K.W.; Richardson, J.M. (Rockwell International Science Center, 1049 Camino Dos Rios, Thousand Oaks, CA 91360). pp 147-170 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes an integrated model for assessing the performance of a given ultrasonic inspection system for detecting internal flaws, where the performance of such a system is measured by probability of detection. The effects of real part geometries on sound propagations are accounted for and the noise spectra due to various noise mechanisms are measured. An ultrasonic inspection simulation computer code has been developed to be able to detect flaws with attributes ranging over an extensive class. The detection decision is considered to be a binary decision based on one received waveform obtained in a pulse-echo or pitch-catch setup. This study focuses on the detectability of flaws using an amplitude thresholding type. Some preliminary results on the detectability of radially oriented cracks in IN-100 for bore-like geometries are given.

24909 **Fatigue and fracture resistance of stainless steel weld deposits after elevated temperature irradiation.** Hawthorne, J.R. (Naval Research Laboratory, Washington, DC). pp 195-220 of Fatigue. Environment and temperature effects. Burke, J.J.; Weiss, V. New York, NY; Plenum Publishing Corp. (1983). (CONF-800741—). Contract AI01-76ET37802.

From 27. sagamore army materials research conference; Bolton Landing, NY, USA (14 Jul 1980).

The fatigue crack growth and fracture resistance of Type 30816 austenitic stainless steel weld deposits were investigated for 427 and 649°C neutron irradiation conditions. The welds (63.5 mm thick) were made by the shielded metal arc process and depicted variations in delta ferrite content from ferrite number 5.2 to 19.0. Specimen irradiations were conducted in the EBR-11 reactor in flowing sodium and static sodium environments. Fatigue crack growth resistances at 427 and 649°C were determined using single-edge-notch (SEN) cantilever fatigue specimens tested in air using a zero-tension-zero loading cycle. Crack growth rates (da/dN) were related to the stress intensity factor range (ΔK). Effects of a tension-hold time of 0.5 minute were explored relative to weld behavior under continuous load cycling conditions. Fracture resistance at elevated temperature was investigated through notch ductility and dynamic fracture toughness determinations by Charpy-V and fatigue precracked Charpy-V test methods respectively.

24910 **Temperature dependent deformation mechanisms of Alloy 718 in low cycle fatigue.** Sanders, T.H.; Embley, G.T.; Frishmuth, R.E. (Fatigue and Fracture Research Laboratory, Georgia Inst. of Technology, Atlanta, GA 30332). pp 163-182 of Fatigue. Environment and temperature effects. Burke, J.J.; Weiss, V. New York, NY; Plenum Publishing Corp. (1983). (CONF-800741—). Contraact AC01-76ET10340.

From 27. sagamore army materials research conference; Bolton Landing, NY, USA (14 Jul 1980).

The low cycle fatigue behavior for water cooled turbine buckets is studied. A series of LCF tests with a transmission electron microscope (TEM) show an inversion in LCF behavior at low strain ranges and long life, the longest cyclic lives occuring at higher temperatures. The plastic strain life curves for 427° has microtwinning as the dominant deformation. The deformation mode was characterized at 538-649° as slip. At 649° the deformation mode shifts from slip band deformation at high frequency to twin band deformation at low frequency. Some type of temperature dependent phenomena appears to control the LCF deformation of Alloy 718.

24911 **Resistance minima in magnetic alloys.** Ruvalds, J. (Physics Dept., Univ. of Virginia, Charlottesville, Virginia 22901). pp 259-287 of Electron correlations in solids, molecules, and atoms. Devreese, J.T.; Brosens, F. New York, NY; Plenum Publishing Corp. (1983). (CONF-8107111—). Contract AS05-81ER10959.

From NATO Advanced Study Institute conference on electron correlations in solids; Turnhout, Belgium (20 Jul 1981).

This chapter examines the influence of coupled magnetic impurities on the transport properties of intermediate concentration alloys. Presents an historical review of resistivity and magnetic susceptibility experiments culminating with the determination of a well defined impurity magnetic moment. Discusses the Kondo effect, the resistance minimum for impurity pairs, and superconductivity. Finds a 1/T divergence in the resistivity (providing that the indirect exchange interaction between impurities is ferromagnetic in nature) which combines with the phonon contribution to form a new type of resistivity minimum. Suggests that since the physical origin of the RKKYinduced divergence is related to the localized character of the magnetic impurity energy level, it may be worthwhile to examine analogous conditions in non-magnetic many body electronic systems.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 24950

24912 **(LBL—16959) Low temperature sintering of Al_2O_3-CaO.** Wu, S.J. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010713.

Portions are illegible in microfiche products; Thesis.

Research was conducted to study the effect of CaO addition on the pre-eutectic densification of alpha-alumina powders. Two sintering methods were used: (a) constant heating rate sintering and (b) constant temperature sintering. The microstructure evolution was examined extensively by scanning and transmission electron microscopy and by x-ray diffractometry. It was found that the addition of CaO activates several mechanisms affecting the densification rate of Al_2O_3-CaO powder compacts. Among them, a solid solution effect and a second phase effect decreased the sintering rate. However, enhanced pre-eutectic densification effect was also observed within a narrow range of composition.

24913 **Effect of crystallities on size of flaws introduced during surface damage in glass-ceramics.** Morena, R.; Hasselman, D.P.H.; Niihara, K. (Dept. of Materials Eng., Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061). pp 145-161 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract AS05-81ER10937.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter reports on a study of the microstructural variables which affect the introduction of surface flaws in a cordierite glass-ceramic during surface damage simulated by micro-hardness indentation. Finds that for matrices containing large crystallites, flaw-crystallite interactions can limit the size of the resulting flaws. Points out that this effect is absent for very small flaws or for those microstructures consisting of only small crystallites, and that these flaw-crystallite interactions result in a crack size-dependent fracture toughness. Discusses the implication of these observations to the crack growth behavior and failure prediction of glass-ceramic materials and brittle matrix composites.

24914 **Effects of oxidation on the reliability of silicon nitride.** Tighe, N.J.; Wiederhorn, S.M. (National Bureau of Standards, Washington, DC 20234). pp 403-423 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract EA-77-A-01-6010-057.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter examines how oxidation at 1200° C affects the strength and reliability of hot-pressed, magnesia-doped silicon nitride by modifying the flaw population. Uses static load data and microstructural examination to identify new flaw populations and to describe the failure mechanism. Displays the analysis graphically by means of a strength degradation map which delineates specific regions for the failures due to pit formation, crack growth, cavitation, and creep rupture. Finds that under constant stress conditions, during heating at 1200° C, the strength of hot-pressed silicon nitride showed 3 time dependent regions of behavior: 1) crack healing, leading to strength enhancement; 2) pit formation, a corrosion reaction which changes the flaw population to a more uniform size distribution; and 3) creep, whereby extensive cavitation, grain deformation, and diffusional grain boundary sliding result in plastic deformation and fracture from extensive flawed regions.

24915 Biaxial stress state effects on strengths of ceramics failing from pores. Shetty, D.K.; Duckworth, W.H.; Rosenfield, A.R. (Battelle Columbus Laboratories, 505 King Ave., Columbus, OH 43201). pp 531-542 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract W-7405-ENG-92.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter reexamines the problem of the failure of brittle ceramics from stress-concentrating flaws, such as pores and surface pits, in general biaxial stress states. Uses fracture-mechanics analysis to show that the trend of higher strengths in biaxial tension and lower strengths in tension-compression stress states in relation to uniaxial tension can be expected in those ceramics that fail from stress-concentrating defects such as pores or surface pits. Develops a stress-intensity solution and failure criterion for brittle fracture from spherical voids. Analyzes experimental results on a glass-ceramic. Demonstrates that strength-controlling cracks in brittle materials, when associated with bulk, stress-concentrating defects, can have different severity in different stress states. Points out that the key parameter in the analysis that determines the extent of the influence of the stress state on the flaw severity is the critical crack size relative to the size of the stress-concentrating defect.

24916 Toughening in glass ceramics through micro-structural design: Measurements, transformations, and high-temperature fracture. Mecholsky, J.J.; Evans, A.G.; Hassleman, D.P.H; Lange, F.F. (Sandia National Laboratories, Albuquerque, NM 87185). pp 165-180 of Fracture mechanics of ceramics. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract AC04-76DP00789.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter reviews and interprets pertinent literature to establish the effect of several material parameters on fracture toughness, K/SUB IC/, of glass ceramics. Applies toughening mechanisms established for ceramic materials to glass ceramic systems and develops the following techniques for toughening glass ceramics: phase separation, internal stress, morphological interaction, stress induced phase transformation, and combinations of these techniques. Presents the toughening techniques available by controlling microstructure in glass ceramic systems and provides examples of glass ceramics available as models of the toughening process. Finds that phase separation in glass increases K/SUB IC/ by 20% to 30% over homogenous glass for specific phase sizes; internal stress brought about by either crystallization, thermal expansion anisotropy, thermal expansion mismatch, or elastic mismatch/anisotropy leads to toughening by either microcracking or crack deflection/interaction; a morphology change from spherical to tabular crystals leads to a 100% increase in K/SUB IC/ in a $3BaOx5SiO_2$ glass ceramic; a stress induced phase transformation is possible in glass ceramics containing zirconia; combinations of toughening techniques can be microstructurally designed to optimize the toughness and strength of glass ceramics; and selected phase separated glasses and glass ceramics are ideal choices for testing mathematical models of toughening mechanisms.

24917 Thermodynamics of phase transformation toughening: Measurements, transformations, and high-temperature fracture. Burns, S.J.; Michener, J.R. (Materials Science Program Dept. of Mechanical Engineering, University of Rochester, Rochester, NY 14627). pp 275-287 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract AC02-81ER10856.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter examines a solid that is fracture toughened by a phase transformation at the crack tip. Uses thermodynamic energy balances for coupling phase transformations to cracking. Discusses specific entropy producing models. Concludes that phase transformation toughening is strongly related to the negative coefficient of thermal expansion and the volume contraction in the phase transformation in ZrO_2; the effect is the opposite of the embrittlement in ordinary phase transformations; and without a negative volume change upon heating or a positive volume change upon cooling the material would not be fracture toughened.

24918 High temperature failure in ceramics: Measurements, transformations, and high-temperature fracture. Evans, A.G.; Blumenthal, W. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Dept. of Materials Science and Mineral Engineering, University of California, Berkeley, CA 94720). pp 423-448 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract W-7405-ENG-48.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter characterizes crack propagation, and examines cavitation mechanisms of crack nucleation. Presents the implications for deriving engineering failure reactions and for microstructural design. Discusses morphological observations; crack tip fields; crack growth data; crack growth models; cavitation origins; constraints on cavity growth; constrained cavity propagation; single phase materials; two phase materials; cavity coalescence; non-interactive coalescence; zone spreading; and premature crack nucleation. Demonstrates the inhomogeneous nature of high temperature failure in ceramics. Concludes that when crack growth controls failure (as might be expected, for example, in the presence of surface cracks subject to stress intensity levels in excess of the threshold), the loading parameter used to describe the crack growth rate should be chosen carefully.

24919 Crack growth in sialon: Measurements, transformations, and high-temperature fracture. Fields, R.J.; Chuang, T.J.; Chuck, L.; Fuller, E.R. Jr.; Kobayashi, K. (National Bureau of Standards, Washington, DC). pp 463-473 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—). Contract AI05-80OR20679.

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter presents an analysis of the bending of notched bars for determining crack growth behavior directly from load-displacement records. Evaluates the analysis by experiments on glass bars in water. Applies the analysis to the slow fracture of various silicon compositions. Gives micrographs of the resulting fracture surfaces and examines a possible mechanism of crack growth in these materials. Discusses testing the analysis and application to sialons. Establishes a method for determining v-K data from load-displacement records by determining the compliance of cracked bars in four point bending. Points out that the method does not require a knowledge of the material's elastic properties or the machine compliance. Results of the testing on glass fractured in water and on sialon bars indicate that the rates of oxidation and slow crack growth in sialons decrease with increasing concentrations of aluminium.

24920 Dilution effects in the photoacoustic spectra of powdered Ho_2O_3 and Er_2O_3 mixtures. Carlson, K.D.; Hodul, D. (Argonne National Lab., IL). *Journal of Photoacoustics;* 1: No. 2, 291-307(1982). Contract W-31-109-ENG-38.

The photoacoustic (PA) spectrum of a powdered solid which is mixed with an optically transparent material is not in general proportional, in terms of intensities, to the spectrum of the pure solid. This dilution effect and related aspects which influence the PA spectra of polycrystalline solids are described in this article for experiments with powdered mixtures of holmium oxide (Ho_2O_3) and erbium oxide (Er_2O_3). 3 figures, 2 tables.

3604 Polymers And Plastics

24921 (PNL-SA—11527) Nondestructive technique for assessing field seam quality of prefabricated geomembranes. Spanner, G.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 6p. (CONF-8406102—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84008386.

From International conference on geomembranes; Denver, CO, USA (20 Jun 1984).

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Research was conducted to test various nondestructive testing (NDT) methods that are or can be used to assess the quality of field seams in synthetic geomembranes. The objective of the work was to find a universally applicable technique and demonstrate its capabilities for field use on actual field seams. The research was conducted in two phases: laboratory investigations and a field demonstration. Sixteen different geomembane materials were considered with assorted seam defects including sand inclusions, gas bubbles, and masking tape spots. One technique, ultrasonic impedance plane analysis (UIP), was found to work on nearly all of the seams studied, including seams made from materials with woven scrim reinforcement. The UIP technique was demonstrated under simulated field conditions on a variey of materials. Conventional pulse-echo ultrasonic testing (UT) was found to be applicable to most of the nonreinforced materials. 7 figures.

24922 **(SAND—84-0094C) Kinetic model for extrapolation of combined radiation-thermal accelerated aging experiments.** Gillen, K.T.; Clough, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 6p. (CONF-840614—12). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005804.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

A general theoretical model has been derived for the case of oxidative degradation dominated by the slow breakdown of hydroperoxide species. The model has been used to predict the general form of dose-rate effects for this mechanism. The model also suggests a method for creating isothermal dose-rate curves through a time-temperature dose rate superposition procedure which utilizes no adjustable parameters. The superposition procedure and the kinetic model are quantitatively verified using accelerated aging laboratory data and real-time nuclear power plant aging data on a PVC and a PE material. Although oxidative degradation is discussed in this paper, the general form of the theoretical model should allow it to be applied to oxidative crosslinking as well. 1 reference, 1 figure.

24923 **Restrictions on life-prediction methodology in polymers.** Christensen, R.M. (Lawrence Livermore National Lab., CA). *Mechanics Research Communications;* **9**: No. 4, 241-250(1982). Contract W-7405-ENG-48.

Kinetic theories of crack growth have been used in the past to estimate the lifetimes of load-bearing polymeric materials. The theme is simple. Knowledge of the kinetic criterion involving stress-versus-crack velocity allows prediction of the time at which the crack reaches an unstable size, thereby causing failure of the structure. The present work shows some of the complications inherent in constant stress life-prediction methodology, specifically, the complications of using different theoretical results. These differences involve the following, both with respect to the governing creep functions: first, the forms of the arguments obtained from different kinetic theories and, second, the various forms for the power-law representation. Some further complications are discussed in relation to conditions wherein the material is in a continuously relaxing state rather than a full relaxed state under the time-constant history. Theoretical means are derived to overcome some of these difficulties. 1 figure, 1 table.

24924 **Solution and transport of water vapor in poly(acrylonitrile): a re-examination.** Mauze, G.R.; Stern, S.A. (Syracuse Univ., NY). *Journal of Membrane Science;* **12**: 51-64(1982).

Solubility (sorption) and transport measurements of water vapor in poly(acrylonitrile) reported by Stannett, Haider, Koros, and Hopfenberg [Poly. Eng. Sci., 20 (1980) 300] have been re-interpreted in terms of an extension of the dual-sorption model for glassy polymers. The extension of the model assumes solubility and diffusion coefficients that are dependent on concentration, and partial immobilization of some of the penetrant species dissolved in the polymer. Satisfactory agreement has been obtained between theory and the experimental data. 21 references, 7 figures, 1 table.

3606 Other Materials

REFER ALSO TO CITATION(S) 24672, 24673, 24913, 24916, 24948

24925 **(UCID—20052) SEM studies of stressed and irradiated Climax Stock quartz monzonite.** Beiriger, J.M.; Durham, W.B. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010921.

In an effort to find the mechanism by which gamma irradiation weakens the unconfined compressive strength of Climax Stock quartz monzonite (CSQM), sections of rock which had been irradiated and loaded to near failure were studied by scanning electron microscopy and compared to sections of rock which had been loaded but not irradiated. The quantities measured and compared were numbers and lengths of microfractures in the rock. We found that the crack parameters depended neither on irradiation treatment nor even on stress history, except in one sample which actually failed. By comparison to cracks counted in other granites by other workers, the crack statistics on CSQM are much noisier and much less indicative of stress history. CSQM is structurally more heterogeneous than the other granites, which is probably the cause of the greater noise level. 12 references, 3 figures, 5 tables.

24926 **The economics of long distance thermal energy transport for district applications.** Rubin, A.; Karnitz, M.A.; Kolb, J.O. (U.S. Department of Energy, Washington, DC). *Alternative Energy Sources;* **8**: 71-80(Dec 1980). (CONF-801210—). Contract W-7405-ENG-26.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

This paper analyzes the economic viability of long-distance energy transport using hot water for U.S. conditions. The analysis is based on a number of cost estimates for installed hot water piping systems in both rural and urban areas. The total cost of delivered thermal energy, including operation and maintenance, is calculated as a function of transport distance, load factor, pipe diameter, and temperature difference between the supply and return water lines. A typical private utility fixed charge rate of 18 percent is assumed. Delivered energy transport costs from remote power plants are then compared to the cost of energy from an oil-fired boiler in individual buildings. Results of the analysis show that for oil costing $30 per barrel, it is economically feasible, for reasonable load factors and temperature differences between supply and return lines, to transport thermal energy up to distances of 20 to 40 miles, depending on the heat delivery capacity of the transport lines.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 24656, 24945, 24945, 24967, 25002, 25054, 25086

24927 **(LBL—17472) Scattering optical activity of chiral molecules: circular intensity differential scattering and circular differential imaging.** Keller, D.J. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098;AT03-82ER60090. 253p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84010712.

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Theoretical treatments are presented for two new techniques based on the ability of chiral molecules to preferentially scatter or absorb right and left circularly polarized light: circular intensity differential scattering (CIDS) and circular differential imaging (CDI). For CIDS, a theory is presented based on classical electrodynamics for scattering in the second Born approximation. The extension of the CIDS theory to the second Born approximation has resulted in new behavior for forward scattered light and systems of isotropic scatterers. Next, a quantum mechanical theory for CIDS is presented. For CDI a theory is presented, based in part on the classical theory for CIDS mentioned above. Two types of differential images are possible: a) darkfield images formed from light reflected or scattered by the sample, and b) brightfield images formed from

light transmitted through the sample. The sign and magnitude of each feature in a circular differential image are proportional to the optical activity of the corresponding feature in the sample. For incident light with wavelengths in the visible, the darkfield circular differential images are mostly sensitive to large features with dimensions similar to the wavelength, while the brightfield images are most sensitive to the short range molecular order.

24928 **Raman spectrometric determination of tribasic sodium phosphate hydrolysis quotient.** Miller, A.G.; Macklin, J.W. (Rockwell Hanford Operations, Richland, WA). *Analytical Chemistry;* **55**: No. 4, 684-687(Apr 1983). Contract AC06-77RL01030.

The hydrolysis quotient of tribasic sodium phosphate has been determined over the 0.001 to 0.4 M phosphate concentration range in order to establish hydroxide concentration limits for the quantitative determination of PO_4^{3-} in aqueous solutions by laser Raman spectrometry. Concentrations of phosphate species in the hydrolysis equilibrium were measured by laser Raman spectrometry and hydroxide concentrations were determined by both pH measurement and a titrimetric method. The hydrolysis quotient ranged from near 0.004 M at phosphate concentrations above 0.01 M to 0.014 M at infinite dilution. This corresponds to a thermodynamic equilibrium constant 7.1 X 10^{-13} M, for the third dissociation of phosphoric acid. These results are compared with those of the only previous Raman spectrometric investigation of the HPO_4^{2-}-PO_4^{3-} equilibrium.

24929 **Determination of sup(113m)Cd in natural water.** Palagyi, S. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice (Czechoslovakia)); Larsen, R.P. (Argonne National Lab., IL (USA)). *Journal of Radioanalytical Chemistry;* **80**: No. 1-2, 141-152(1983). (CONF-8204145—).

From 10. radiochemical conference; Marianske Lazne, Czechoslovakia (26 Apr 1982).

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A method has been developed for the determination of sup(113m)Cd from fallout in large-volume environmental water samples. In the analytical procedure a known amount of cadmium carrier is added to the sample and the cadmium is preconcentrated as insoluble hydroxide by coprecipitation with ferric hydroxide. The separated cadmium is purified from other interfering elements by an ion-exchange procedure. Finally, cadmium is coprecipitated with copper sulfide, and the radioactivity of sup(113m)Cs is measured in a low-background, gas-flow proportional beta counter. The cadmium recovery is established by determining the amount of Cd in the precipitate using an energy dispersive X-ray fluorescence spectrometer. For a 24hr counting period a lower limit of detection around 50μBq sup(113m)Cd/l of sample has been attained. Samples of Lake Michigan water were analyzed: the concentration of sup(113m)Cd in 1980 was 177+-μBq/l.

24930 **(LA-tr—83-26) Determination of trace elements in water with a high iron content by atomic absorption spectrometry.** Sourova, J.; Capkova, A. Translated from *Vodni Hospodarstvi, [Rada] B ;* No. 5, 133-136(1983). Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010377. DE84010377

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The proposed method is sufficiently reliable and suitable for serial operation. It makes it possible to determine Ag, Cd, Cu and Ni in concentrations of 0.5 to 100 $\mu g.l^{-1}$ and Pb in a concentration of 2 to 200 $\mu g.l^{-1}$ in water samples that contain up to 200 $mg.l^{-1}$ of iron. In a range of 25 to 100 $\mu g.l^{-1}$ of trace elements the relative definitive deviations are less than 5%. The described method has been operationally tested and is used for analysis of subterranean waters and rock extracts.

24931 **Determination of n-butylated trialkyllead compounds by gas chromatography with microwave plasma emission detection.** Estes, S.A.; Uden, P.C.; Barnes, R.M. (Univ. of Massachusetts, Amherst). *Analytical Chemistry;* **54**: No. 14, 2402-2405(Dec 1982).

An analytical gas chromatographic procedure is described for the determination of trialkyllead compounds in aqueous media. The analyte compounds are extracted into benzene from an aqueous solution saturated with sodium chloride. They are then quantitatively converted into n-butyltrialkyllead derivatives by reaction with an n-butyl Grignard reagent. Precolumn Tenax trap enrichment of the derived trialkylbutylleads enables determination to low ppB levels to be carried out. Also investigated are extraction efficiencies and injection split ratios onto a fused silica capillary column. Lead specific detection is by atmospheric pressure microwave induced plasma spectrometric emission. Data are presented for a wastewater effluent sample. 21 references, 3 figures.

24932 **Microcomputer-controlled hot-cell pipetting system.** Goeringer, D.E.; Klatt, L.N. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **54**: No. 11, 1902-1904(Sep 1982). Contract W-7405-ENG-26.

The remote pipetting system described in this brief report enables sample aliquots to be accurately and precisely delivered in remote environments. The reliable, independent control afforded by a microcomputer facilitates operator interaction and provides accurate documentation of operations. Major features include electronic sensing of the plunger position, stand alone operation, a software driven self-test of the electronic and mechanical systems, hard copy output of pertinent operational information (placed directly on the analyst's work control sheet), and the capability to implement direct communication with a time-shared data management system. 4 figures, 1 table.

24933 **Calculation of the reduced surface excess from continuous flow frontal analysis solid-liquid chromatography.** Noll, L.A.; Burchfield, T.E. (Dept. of Energy, Bartlesville, OK). *Colloids and Surfaces;* **5**: 33-42(1982).

The article describes the calculation of the reduced surface excess from a continuous flow experiment. The desirability of using surface excess is considered. The usual method of frontal analysis is explained, and its shortcomings are briefly mentioned. The results of both methods of calculation are shown using the Everett model, and these results are compared with each other and with the thermal data gathered simultaneously. Calculation of surface excess for a flowing multicomponent system is outlined. 4 figures, 3 tables.

24934 **Multi-disciplinary analysis of Tell el Yahudiyeh ware.** Kaplan, M.F.; Harbottle, G.; Sayre, E.V. (Brookhaven National Lab., Upton, NY). *Archaeometry;* **24**: No. 2, 127-142(1982).

Correlation of both the archeological and chemical analyses are promising. The typological and geographical analyses suggest that Cylindrical 1 and Globular type vessels were manufactured in the Nile Valley. Every sample taken from a vessel of this type has a chemical composition which matches one of the Nile Valley sources. The archeological analyses suggest that Cylindrical 2, Piriform 2b and 3, Biconical 2, and Ovoid were manufactured in the Levant. Again, every sample from a vessel of these types matched a Levantine Clay source. Of the remaining types, Piriform 1 and 2a and Biconical 1, there are only 2 samples from each type which were not manufactured in the Nile Valley. There are only Levantine copies of Egyptian wares; there are no Egyptian copies of Levantine types. The near perfect correlation of the results of the chemical analyses with those of the archeological analyses allows the postulation of the existence of the 2 families of the ware, one Egyptian and one Levantine. 11 figures, 2 tables.

24935 **Oligomer analysis by HPLC and GPC.** Curtis, M.A.; Rogers, L.B. (Univ. of Georgia, Athens). *Journal of Liquid Chromatography;* **5(Suppl. 2)**: 319-329(1982).

The studies selected for this review indicate that the high performance liquid chromatography and gel permeation chromatography are useful for separation of oligomers of various species. Typical applications are described. The advantages and disadvantages of the methods are compared. The types of columns and nature of packing materials are described.

24936 Improved sensitivity of infrared spectroscopy by the application of least squares methods. Haaland, D.M.; Easterling, R.G. (Sandia National Labs., Albuquerque, NM). *Applied Spectroscopy;* **34**: No. 5, 539-548(1980). Contract AC04-76DP00789.

Improved sensitivity and precision in the quantitative analysis of trace gases by Fourier transform infrared spectroscopy have been achieved by the application of new spectral least squares methods. By relating all of the spectral information present in the reference spectrum of a trace gas to that of the unknown sample and by appropriately fitting the baseline, detections of trace gases can be obtained even though the individual spectral features may lie well below the noise level. Four least squares methods incorporating different baseline assumptions were investigated and compared using calibrated gases of CO, N_2O, and CO_2 in dry air. These methods include: (I) baseline known, (II) baseline linear over the spectral region of interest, (III) baseline linear over each spectral peak, and (IV) negligible baseline shift between successive data points. Methods III and IV were found to be most reliable for the gases studied, When method III is applied to the spectra of these trace gases, detection limits improved by factors of 5 to 7 over conventional methods applied to the same data. Three sigma detection limits are equal to 0.6, 0.2, and 0.08 ppM for CO, N_2O, and CO_2, respectively, when a 10-cm pathlength at a total pressure of 640 Torr is used with a ~ 35 min measurement time at 0.06 cm^{-1} resolution. 10 references, 2 figures, 4 tables.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 24605, 24650, 24661, 24924, 24928, 24959, 24969, 24981, 24986, 24988, 24989

24937 (BNL—51714, pp 58-61) **High resolution spectroscopy of small molecules.** Hardwick, J.L.; Winicur, D.H. (Univ. of Notre Dame, IN). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Spectra of several small molecules are being studied at high resolution using an asymmetric Czerny-Turner spectrograph designed and constructed at the Notre Dame Radiation Laboratory. Fluorescence of nitrogen dioxide excited by the 4545A° line of the Ar^+ laser has been dispersed and recorded at Doppler limited resolution. A simultaneous fit has been performed of virtual spin-free combination differences of the ground vibrational state of NO_2 taken from infrared, microwave, and fluorescence spectra. This simultaneous fit yields rotational constants with smaller statistical uncertainty and superior ability than constants derived from any single spectrum. Collisional satellite lines have also been observed in fluorescence excited under the same conditions. Energy transfer from He^* to acetylene has been used to produce a bright source of C_2 molecules in several excited electronic states.

24938 (BNL—51714, pp 68-73) **Sensitivity methods for model analysis and validation.** Rabitz, H. (Princeton Univ., NJ). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

New developments in sensitivity analysis particularly relevant to differential equation models will be discussed in this paper. The primary focus will be on initial value problems although some material relevant to boundary value problems and mixed initial-boundary value problems will be discussed. The theory and methodology will be illustrated by examples from chemical kinetics including transport. Emphasis will be placed on the utilization of partial derivatives and functional derivative sensitivity gradients. 16 references, 6 figures.

24939 (LBL—17311) Calculation of the thermodynamic properties of gases. Brewer, L.; Hahn, S. (Lawrence Berkeley Lab., CA (USA)). Dec 1983. Contract AC03-76SF00098. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010580.

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The several programs tabulated in this document are designed to calculate the translational, electronic, vibrational and rotational contributions to the thermodynamic functions of gaseous molecules.

24940 (LBL—17640) Quantum mechanical approaches to chemical reaction dynamics. Schwartz, S.D. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010714.

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We first investigate a method to treat the dynamics of large chemical reactions using the Distorted Wave Born Approximation. We employ the concept of separation of the entire dynamical problem into a system and a bath of modes which are weakly coupled to the system. It is felt that because chemical reactions are usually site specific, hence highly localized phenomena, this method of attack will prove useful. This use of scattering perturbation theory differs from more common approaches; in that it couples degrees of freedom rather than quantum states. The theory is applied to the reaction $H+H_2$, and even in this very small reaction, highly accurate results obtain. The second theoretical approach we employ is a casting of exact quantum mechanical rate constants in terms of various statistical mechanical correlation functions. The correlation functions depend on evaluation of the Feynman propagator for the system at complex values of the time. Methods are developed to apply these formulae to specific cases. Propagators are evaluated along the real line, and then numerically continued into the complex plane to yield the desired result. The final chapter deals with a model for the interaction of oscillators with reaction paths through the variation of frequency in the oscillator as it proceeds along the reaction path. The model forms an analogy to simple quantum field theory. In application to an elementary bound state test problem highly accurate results are produced.

24941 Gas-phase reactions of FeO^+ with hydrocarbons. Jackson, T.C.; Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **106**: No. 5, 1252-1257(Mar 1984). Contract AC02-80ER10689.

The reactions of FeO^+ with linear alkanes, cyclic alkanes, and branched alkanes are presented. In general from the reactions observed, it appears that FeO^+ is more reactive toward alkanes than Fe^+ which is due mainly to the greater reaction exothermicity involved in H_2O loss. The majority of the products observed may be explained by initial C-H insertion and loss of H_2O to produce an activated Fe^+-olefin complex which subsequently decomposes. An alternative mechanism involving C-C insertion, however, cannot be ruled out and is in fact supported by observation of radical loss products. These radical loss products dominate for systems in which C-H insertion pathways are inhibited by the absence of β hydrogens. 1 figure, 4 tables.

24942 Matrix isolation infrared and Moessbauer studies of the oxidative addition reactions of hydrogen halides with iron atoms. Parker, S.F.; Peden, C.H.F.; Barrett, P.H.; Pearson, R.G. (Univ. of California, Santa Barbara). *Journal of the American Chemical Society;* **106**: No. 5, 1304-1308(Mar 1984). Contract AM03-76SF00034.

The reactions of the hydrogen halides with iron atoms in inert matrices lead to the previously unknown molecules H-Fe-X (X = Cl, Br, I). Infrared studies with Ar/Fe/HX (5%) and Kr/Fe/HX (5%) show one new band in the region 1735-1755 cm^{-1}. This is assigned to the iron-hydride stretch of H-Fe-X. Moessbauer studies of Ar/Fe/HX (5%) show the formation of one major product in each case. These products all have isomer shifts characteristic of Fe(II) complexes, hence they are similarly assigned to the oxidative addition product H-Fe-X. Moessbauer studies using Ar/Fe/HF show different behavior. At 6 K, two products are observed. These are assigned to an Fe(FH) complex, and to matrix isolated FeF_2. Warming this sample to 77 K causes loss of the matrix, leaving amorphous FeF_2 and FeF_3. 6 figures, 2 tables.

24943 Laser photodissociation of $Hg(CH_3)_2$: infrared emission studies of vibrational and rotational excitation in the CH_3 fragments. Baughcum, S.L. (National Bureau of Standards, Boulder, CO); Leone, S.R. *Chemical Physics Letters;* **89**: No. 3, 183-188(18 Jun 1982).

Single-photon dissociation of $Hg(CH_3)_2$ [dimethyl mercury] at 248 and 193 nm produces CH_3 radicals with substantial excitation in the nu_3 out-of-plane bend and the nu_3 antisymmetric stretch. At 248 nm the antisymmetric stretch excitation is characterized by a 1200 to 1500 K rotational temperature and a vibrational distribution nu=1:nu=2:nu=3 of 1.0:0.2+-0.1:0.05+-0.05. 2 figures.

24944 Coordination of Fe^{3+} in sodium disilicate glass. Park, J.W.; Chen, H. (Univ. of Illinois, Urbana). *Physics and Chemistry of Glasses;* **23**: No. 3, 107-108(Jun 1982).

Since uncertainty remains regarding the coordination number of the ferric (Fe^{3+}) ion in a sodium silicate glass, x-ray absorption fine structure (EXAFS) measurements were performed on a carefully prepared thin glass plate in order to obtain the absolute number of near-neighbor atoms surrounding the cation. A plate ca 70 μm thick was prepared by thin section grinding and metallographic polishing. Data are shown for EXAFS oscillations and their Fourier transformation for a sodium disilicate glass containing 20 mol % ferric oxide. A least square fitting result yielded the following values; the interatomic distance between Fe^{3+} ion and its nearest neighbor oxygen atoms is 2.03_3 A, the Debye-Waller factor is 0.06_1 A, and the magnitude A is 0.87_6 A^{-2}. This magnitude is in turn related to the coordination number as given in the 2nd equation, in which the inelastic mean free path (λ) needs to be estimated before the coordination number may be obtained. λ is typically between 5 and 8 A for both crystalline and amorphous materials. The EXAFS measurement supports the concept that the $Fe^3\mu$ ion in sodium disilicate glass is in octahedral coordination. 2 figures.

24945 Effect of the organic ligand on the response for vanadium in flame atomic emission spectrometry. Wood, B.J.; Galobardes, J.F.; Rogers, L.B. (Univ. of Georgia, Athens). *Analytica Chimica Acta;* **135**: 145-152(1982).

Flame emission intensities from vanadium in the forms of chelates with N-nitrosophenylhydroxylamine and 8-quinolinol in methyl isobutyl ketone were measured. Although differences in atomic absorption characteristics for vanadium bound by different ligands have been reported, significant differences were not found in the emission intensities of these two chelates after signals for the appropriate blanks had been subtracted. 1 figure, 2 tables.

24946 Partial molar volume of Fe_2O_3 in multicomponent silicate liquids and the pressure dependence of oxygen fugacity in magmas. Mo, X.; Carmichael, S.E.; Rivers, M.; Stebbins, J. (Lawrence Berkeley Lab., CA). *Mineralogical Magazine;* **45**: 237-245(1982). Contract W-7405-ENG-48.

Density measurements of eight silicate liquids containing substantial amounts of Fe_2O_3 have been made over a range of 250°C. These have been combined with published density measurements on multicomponent silicate liquids to yield (by multiple regression) partial molar volumes of SiO_2, TiO_2, Al_2O_3, e_2O_3, FeO, MgO, CaO, Na_2O, and K_2O. The data on Fe_2O_3-liquids are neither precise nor abundant enough to show a compositional dependence of the partial molar volume of liquid Fe_2O_3. An equation is given that expresses the dependence of the oxygen fugacity in a liquid of constant composition and temperature. Combining an equation relating oxygen fugacity to composition, T,and Fe_2O_3 at 1 bar (Sack et al., 1980) with the results for partial molar volumes, the oxygen fugacity of any magma can be calculated as a function of P and T. If basic magmas have their Fe_2O_3/FeO set in the source regions, and ascend isochemically, then the calculated oxygen fugacities in the mantle increase as pressure increases and silica activity decreases. A P-T grid has been constructed to show the calculated oxygen fugacities in a source region which has equilibrated with some common lava types, based on their FeO and Fe_2O_3 contents. 31 references.

24947 Role of inner-sphere configuration changes in electron-exchange reactions of metal complexes. Brunschwig, B.S.; Creutz, C.; Macartney, D.H.; Sham, T.K.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Faraday Discussions of the Chemical Society;* **74**: 113-127(1982).

EXAFS (extended x-ray absorption finstructure) techniques were used to measure differences in the metal-ligand bond distances Δd_0 for the following couples, (couple, Δd_0/A): [iron(Fe), cobalt(Co), ruthenium(Ru), and chromium(Cr) complexes; hydrates(H_2O), phenanthroline(phen), bipyridine(bpy), ammonia(NH_3)]: $Fe(H_2O)_6$/sup 2+/3+/, 0.13; $Fe(CN)_6$/sup 4-/3-/ (ferricyanides), 0.01; $Fe(phen)_3$/sup 2+/3+/, 0.00; $Co(NH_3)_6$/sup 2+/3+/, 0.22; $Co(bpy)_3$/sup +/2+/, -0.02; $Co(phen)_3$/sup 2+/3+/, 0.19; $Ru(H_2O)_6$/sup 2+/3+/, 0.08; $Ru(NH_3)_6$/sup 2+/3+/, 0.04. The $Cr(H_2O)_3^{2+}$ ion hs four short and two long Cr--O bonds (2.07 and 2.30 A, respectively) and the average Δd_0 for the $Cr(H_2O)_6$/sup 2+/3+/ couple is 0.20 A. The rate constant for the $Fe(H_2O)_6^{2+}/Fe(H_2O)_6^{3+}$ exchange reaction is 1.1 $dm^3mol^{-1}s^{-1}$ at 25°C and 0.1 mol dm^{-3} ionic strength. The exchange rate is independent of the cation ($lithium^+$/$sodium^+$) used to maintain constant ionic strength. Exchange rate constants for twelve reactions which span fifteen orders of magnitude are known to be in agreement with the semi-classical model. 3 figures, 2 tables.

24948 Investigation of phase separation by Raman spectroscopy. White, W.B. (Pennsylvania State Univ., University Park). *Journal of Non-Crystalline Solids;* **49**: 321-329(1982). Contract AC02-76ER02754.

Raman spectra of silica and borate glasses characteristically consist of a few rather broad bands, the frequencies of which are related to the network-forming units - silica tetrahedra, boron triangles, boron tetrahedra, etc. - and the extent to which these units are polymerized. Heat treatment that produced crystallization develops new sharp Raman bands which increase in intensity with time of heat treatment and which measure the evolution of the crystalline phases. Raman spectra of heat-treated glasses for which heat treatment produces glass-glass phase separation are in most cases identical to the original glass. Examination of the Raman spectra of phase-separated alkali borate and alkali silicate glasses leads to the conclusion that the melts from which these glasses are prepared are already clustered on an atomic scale so that they contain all of the network-forming linkages that will be segregated into thermodynamically distinct phases after heat treatment. The minimum size of the clusters is difficult to estimate but deductions from the spectra of germano-silicate glasses suggest it must be on the order of 5 to 10 tetrahedra. 4 figures.

24949 Effects of pressure on the kinetics of the dehydration of carbonic acid and the hydrolysis of CO_2 in aqueous solution. van Eldik, R. (Univ. of Frankfurt, Germany); Palmer, D.A. *Journal of Solution Chemistry;* **11**: No. 5, 339-346(1982). Contract W-7405-ENG-26.

The pressure dependence of the dehydration reaction of H_2CO_3 was measured in acidic aqueous solution for pressures up to 1 kbar using a high-pressure stopped-flow instrument. The corresponding volume of activation was found to be 6.4 +- 0.4 cm^3-mol^{-1} at 25°C and 0.5 ionic strength. Volume equation calculations result in a value of -9.9 +- 1.9 cc-mol^{-1} for the volume of activation for the hydrolysis of CO_2 under the same conditions. For the first time, the reaction mechanism can be interpreted in terms of dissociative and associative modes, respectively. These data are used to construct an overall reaction volume profile. 1 figure, 1 table.

24950 Synthesis of iron-nitrogen compounds by rf sputtering: Moessbauer studies. Lo, C.; Krishnaswamy, S.V.; Rao, K.R.P.M.; Messier, R.; Mulay, L.N. (Pennsylvania State Univ., University Park). *Materials Research Bulletin;* **15**: No. 9, 1267-1272(1980).

The preparation of a range of rf-sputtered Fe-N compounds by control of the sputtering parameters is reported. Contrary to earlier reports, it is shown that single phase Fe_4N can be synthesized by the exclusive use of N_2 gas. However, adding H_2 to the sputtering gas improves the ease of formation and the range of control. The x-ray diffraction and Moessbauer data are presented. 9 references, 3 figures, 1 table.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 24933, 24935, 24938, 24941, 24943, 24945, 24947, 24949, 24973, 24974, 24976, 24985, 24988, 24995, 25018, 25060

24951 (BNL—51714, pp 1) **Perspective on the present state of radical reaction rate measurement and theory.** Kaufman, F. (Univ. of Pittsburgh, PA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The field of two-body elementary radical raction kinetics is placed in the context of reaction mechanisms on the one hand and single collision, state-to-state collision dynamics on the other. Direct, two-body reactions with well-defined transition states are discussed using OH-reactions with methane, ethane, substituted methanes and ethanes, and hydrogen as examples. Turning to complex, two-body reactions, we discuss the confusing state of the important atom-molecule reaction, O + C_2H_4, whose product channels are still in some doubt, in the context of new results from our laboratory. Lastly, radical-radical reactions such as H, O, or OH + HO_2 are discussed, mainly from the point of view of their experimental problems.

24952 (BNL—51714, pp 2-6) **Kinetics and mechanisms of alternative fuels combustion.** Klemm, R.B.; Michael, J.V. (Brookhaven National Lab., Upton, NY). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The objectives of this project are to make measurements of absolute rate constants for elementary combustion related reactions, and to investigate mechanistic factors involved gas phase combustion and pollutant formation processes. Progress has been made in four distinct phases of the project and details are given under the following headings: (1) shock tube; (2) hydroxyl-radical reaction kinetics; (3) chemical kinetic modelling; and (4) discharge flow-photoionization mass spectrometer-national synchotron light source. 4 references, 1 table.

24953 (BNL—51714, pp 62-64) **Energy redistribution in acetylene.** Field, R.W.; Kinsey, J.L. (Massachusetts Inst. of Tech., Cambridge). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24954 (BNL—51714, pp 176-178) **Further investigation on the reaction of O(^{3}P) with acytlene by the crossed molecular beams method.** Buss, R.J.; Baseman, R.J.; He, G.; Lee, Y.T. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—). Contract AC03-76SF00098.

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

An earlier crossed beam experiment in our laboratory on the reaction of O(^{3}P) with acetylene identified the hydrogen atom elimination reaction, giving H + C_2HO as the major channel at the high collision energy of 7.9 kcal/mole. The second reaction, giving CO + CH_2, which requires a hydrogen atom migration between adjacent carbon atoms, was observed as a minor channel. However at a lower collision energy of 4.0 kcal/mole, the CO + CH_2 channel was found to have increased 78 +- 9% of the total reaction, thus becoming the major channel. It is known that the O(^{3}P)-C_2H_2 complex could be any of four triplet biradicals but current theory would not predict an easy H atom migration on any of these triplet surfaces. If any of these complexes can undergo rapid intersystem crossing to the singlet biradical, the H-atom migration should become facile and CO + CH_2 would be the principal product. The new observation that the CO channel is favored at low collision energy seems to require a much lower barrier for H migration in OCHCH or the invoking of facile intersystem crossing in the absence of collisions on at least one of the four surfaces. More experimental and theoretical work will be necessary to understand the translational energy dependent ratio of this interesting and important reaction. 3 references.

24955 (BNL—51714, pp 180-185) **Theoretical study of oxidation reactions: mechanism of the O(^{3}P) + H_2CO reaction.** Lester, W.A. Jr.; Dupuis, M. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24956 (BNL—51714, pp 202-206) **Heats of formation of molecules using bond additivity corrections to fourth-order Moller-Plesset perturbation theory.** Binkley, J.S.; Melius, C.F. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24957 **Ionic hydrogen bond and ion solvation. 1. NH^+...O, NH^+...N, and OH^+...O bonds. Correlations with proton affinity. Deviations due to structural effects.** Meot-Ner, M. (National Bureau of Standards, Washington, DC). *Journal of the American Chemical Society;* **106**: No. 5, 1257-1264(Mar 1984).

In dimers BH^+...A a linear correlation is found between dissociation energy $\Delta H°$/sub D/ and the difference (ΔPA) between the proton affinities (PA) of the proton donor B and the proton acceptor A. The correlation applies for 48-NH^+...0-dimers including a series with varying A and constant B, i.e., hydrates of ammonium and pyridium ions (-NH=...OH]3'); a series with varying B and constant A, i.e., complexes $CH_3NH_3^+$...O-; and other dimers with ΔPA values varying from 9 to 70 kcal mol and bond energies from 27 to 12 kcal mol^{-1}. The correlation $\Delta H°$/sub D/ (kcal mol^{-1}) = $\Delta H°$/sub 0/-bΔPA for -NH^+...O- bonds yields the parameters $\Delta H°$/sub D/(0) = 30.0 kcal mol^{-1} and b = 0.26 . Analogous linear correlations are observed for -NH^+-...N-bonds in a set of 8 ammonium ion dimers, and for -OH^+...O- bonds in a set of 21 oxonium ion hydrates, with parameters $\Delta H°$/sub D/(0) = 23.2, b = 0.23 and $\Delta H°$/sub D/ = 30.4,b = 0.30, respectively. Analogous linear correlations apply also for -NH^+...S- and - SH^+...O- bonds. The correlations are in accord with trends predicted by ab initio calculations of Desmeules and Allen. The correlations are reliable predictors of BH^+...A energies within experimental error limits. Deviations from correlations help to identify special structural effects. Such effects include multiple hydrogen bonding, intramolecular hydrogen bonding, resonance, and steric crowding. 4 figures, 4 tables.

24958 **Ionic hydrogen bond and ion solvation. 2. Solvation of onium ions by one to seven H_2O molecules. Relations between monomolecular, specific, and bulk hydration.** Meot-Ner, M. (National Bureau of Standards, Washington, DC). *Journal of the American Chemical Society;* **106**: No. 5, 1265-1272(Mar 1984).

The relation between enthalpies of solvation of onium ions, BH^+, by one water molecule, $-\Delta H°_{0,1}$, and by four water molecules, $-\Delta H°_{0,4}$, is constant for most onium ions: $\Delta H°_{0,4}/\Delta H°_{0,1}$ is 2.8 +/- 0.1 for all oxonium ions and monoprotonic ammonium and pyridium ions, and 3.1 +/- 0.1 for polyprotonic ammonium ions. These relations, in conjunction with the correlation between $\Delta H°_{0,1}$ and the proton affinity difference [ΔPA = PA(B) - PA(H_2O)], allow the prediction of the total four-molecule specific hydration energy $-\Delta H°_{0,4}$ for all onium ions within the experimental accuracy of +/-3 kcal mol^{-1}. The observed (or predicted) fourfold specific relative hydration energies simulate closely the relative bulk hydration enthalpies for most ions. In other words, for most onium ions differential hydration effects are determined by specific hydrogen-bonding interactions. Deviations are useful to identify bulk solvation effects. For example, such deviations indicate attenuated bulk solvation of ions with phenyl substituents. 5 figures, 2 tables.

24959 **Coupling of bridging phosphido ligands with alkyl, hydride, and carbene ligands to give bridge elimination reactions.** Geoffroy, G.L.; Rosenberg, S.; Shulman, P.M.; Whittle, R.R. (Pennsylvania State Univ., University Park). *Journal of the American Chemical Society;* **106**: No. 5, 1519-1521(Mar 1984).

Described are some examples of the degradation of phosphido bridges via coupling with alkyl hydrides and carbene ligands. The experiments outlined demonstrate that the phosphide bridges are not inert and that they can participate in complex reactions. Such bridge elimination reactions may limit the utility of phosphide-bridged complexes in homogenous catalysis.

24960 **Applications of the equivalent cores approximation. The determination of proton affinities and isocyanide-to-nitrile isomerization energies from core binding energies.** Beach, D.B.; Eyermann, C.J.; Smit, S.P.; Xiang, S.F.; Jolly, W.L. (Univ. of California, Berkeley). *Journal of the American Chemical Society;* **106**: No. 3, 536-539(8 Feb 1984). Contract AC03-76SF00098.

Core binding energies were determined for the following gas-phase molecules: CH_2CCH_2, CH_2CO, BH_3CO, HNCO, CH_3CN, CH_3NC, NH_2CN, t-BuNC, and C_6H_5NC. By use of the equivalent cores approximation, these data and data from the literature were used to calculate the proton affinities of N_2O, CO_2, HCCF, NCF, NH_2CN, CH_2N_2, HNCO, CH_2CO, HN_3, CH_3NC, and CH_3CN with an estimated accuracy of +/-7 kcal mol^{-1}. By a similar method, the isocyanide-to-nitrile isomerization energies for CH_3NC, t-BuNC, and C_6H_5NC were calculated to be -30, -27 and -28 kcal mol^{-1}, respectively.

24961 **Paramagnetic carbon-13 shifts induced by the free radical tempo. 2. Nitrogen heterocycles.** Qui, Z.W.; Grant, D.M.; Pugmire, R.J. (Univ. of Utah, Salt Lake City). *Journal of the American Chemical Society;* **106**: No. 3, 557-563(8 Feb 1984). Contract FG22-80PC30226.

With use of the free radical Tempo as a shift and relaxation reagent, both paramagnetic shifts and spin-lattice relaxation rates of nitrogen heterocycles are reported. Paramagnetic shifts of these compounds are larger than the corresponding shifts of the aromatic hydrocarbons, indicating a stronger interaction between nitrogen heterocyclic compounds and Tempo. Paramagnetic shifts increase with the number of nitrogen atoms per molecule. For pyridine type compounds, both shift and relaxation data show that the stronger interaction is not at the adjacent positions to the nitrogen atoms. It would appear in these heterocyclic complexes with Tempo that the nitrogen atoms tend to orient away from the N-O group in Tempo. In contrast, imidazole and indole exhibit a much stronger interaction with the Tempo due to hydrogen bond formation, and the positions near the N-H group exhibit larger paramagnetic shifts and relaxation rates. An approximate static model involving an indole-Tempo, hydrogen-bond complex accounts for the relaxation data from which both an equilibrium constant of complexation and a hydrogen-bond distance in the indole-Tempo complex could be estimated.

24962 **External conditions and interactions in room-temperature phosphorescence of hydroxyl aromatics adsorbed on solid surfaces containing poly(acrylic acid).** Dalterio, R.A.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **55**: No. 7, 1084-1089(Jun 1983). Contract AC02-80ER10624.

Poly(acrylic acid)-salt mixtures were studied as solid surfaces for inducing room-temperature phosphorescence from hydroxyl-substituted aromatic compounds so surface interactions and optimal conditions for room temperature phosphorescence could be determined. The mixtures were examined with respect to the type of salt, salt-polymer ratio, acid-base form of the polymer, and ethanol-water volume ratio of the adsorbing solvent. A solution containing 10% water in ethanol, which was used to adsorb 4-phenylphenol onto a poly(acrylic acid)-NaBr mixture, was found to induce enhanced room-temperature phosphorescence intensity. Infrared data indicated that even with water adsorbed on the poly(acrylic acid)-NaBr matrix room-temperature phosphorescence was observed. A comparison of room- and low-temperature phosphorescence intensities was made with several model compounds to estimate the efficiency of room-temperature phosphorescence from the poly(acrylic acid)-salt matrix. In addition, room-temperature phosphorescence was measured as a function of time to determine the effects of atmospheric humidity on the poly(acrylic acid)-salt matrix. Fluorescence polarization was also used to obtain information about phosphor-poly(acrylic acid) binding in ethanol solutions.

24963 **Molecular Rydberg spectroscopy magnetic field effects in alkyl halides.** McGlynn, S.P. (Louisiana State Univ., Baton Rouge); Scott, J.D.; Felps, W.S. *Journal de Physique (Paris), Colloque;* **43**: No. 11, C2.305-C2.315(Nov 1982).

The total angular momentum of all states of hydrogen iodide (HI), methyl iodide (CH_3I) and its deuterium derivative, and methyl bromide (CH_3Br) in the first s-Rydberg complex is found to be quantized. This observation suggests that the operative symmetry is that of a molecular bit within which the transition is localized, and that the remainder of the molecule is merely perturbed. The angular momenta of various vibrational states have also been measured. Results indicate that non-totally symmetric vibrations coupled to electronic origins often produce profound changes of magnetic moment. A perturbation approach of whole molecule nature has been developed and has the capacity to explain the observations. The perturbation expression includes terms descriptive of (i) deviation of the molecule from non-linearity; (ii) Renner-Teller effects; and (III) Jahn-Teller effects. 5 figures.

24964 **Improved synthesis of certain 3-ethoxycarbonylcoumarins.** Bissell, E.R. (Lawrence Livermore National Lab., CA). *Synthesis;* No. 10, 846-848(Oct 1982). Contract W-7405-ENG-48.

The thermal condensation method for the preparation of 3-ethoxycarbonylcoumarins has been modified so as to be carried out under milder conditions using a Lewis acid catalyst to give increased product yields. Zinc chloride and titanium (IV) chloride were found to be the most effective catalysts tested. Detailed synthesis instructions and product analyses are given for 7-ethylamino-6-methyl-3-ethoxycarbonylcoumarin, 7(pentadecafluorooctylamino)-3-ethoxycarbonylcoumarin, 7-(cyanoethylamino)-3-ethoxycarbonylcoumarin, 7-(ethoxycarbonylamino)-3-ethoxycarbonylcoumarin, 3-hydroxycarbanilic acid p-nitrobenzyl ester, 7-(p-nitrobenzyl)-oxycarbonylamino-3-ethoxycarbonylcoumarin, and 1,1-diethoxycarbonyl-2-(3-hydroxyphenylamino)-ethylene. 33 references, 2 tables. (BLM)

24965 **Photoinduced structural transformations in mixed monolayer assemblies.** Patterson, L.K.; Maccarthy, J.E.; Kozak, J.J. (Univ. of Notre Dame, IN). *Chemical Physics Letters;* **89**: No. 5, 435-437(2 Jul 1982).

In mixed monolayers with stearic acid at the air-water interface, parinaric acid undergoes photochemical reaction, which, in turn, triggers marked structural change in the monolayer assembly. Changes in the fluid-expanded and fluid-compressed regimes are qualitatively different and are interpreted in terms of a simple model. 1 figure.

24966 **Investigation of the lowest triplet state of the pyrochlorophyllide a-apomyoglobin complex by zero-field optically detected magnetic resonance spectroscopy.** Clarke, R.H. (Boston Univ., MA); Hanlon, E.B.; Boxer, S.G. *Chemical Physics Letters;* **89**: No. 1, 41-44(4 Jun 1982). Contract AC02-76ER02570.

The zero-field fluorescence-detected triplet state magnetic resonance spectra have been obtained for the pyrochlorophyllide a-apomyoglobin complex at 2 K. The triplet state zero-field splittings and spin sublevel dynamics were detected on the resolved features of the structured low-temperature fluorescence. Structured fluorescence is not observed for pyrochlorophyllide a in an organic matrix under identical conditions. These data are interpreted in terms of the local binding site of the pyrochlorophyllide a chromophore in the protein and the low-temperature conformation of the protein matrix. 15 references, 1 figure, 1 table.

24967 **High pressure studies of molecular lumenescence.** Drickamer, H.G. (Univ. of Illinois, Urbana). *Annual Review of Physical Chemistry;* **33**: 25-47(1982). Contract AC02-76ER01198.

The studies of high pressure molecular luminescence reviewed, along with results for inorganic systems discussed elsewhere, provide evidence about the versatility and power of high pressure as a tool for characterizing electronic states, testing theories concerning electronic phenomena, and generally obtaining a

better understanding of electronic behavior in condensed systems. 16 figures.

24968 **Computer generation of isomers.** Balasubramanian, K. (Lawrence Berkeley Lab., CA). *Computers and Chemistry;* **6**: No. 2, 57-63(1982). Contract W-7405-ENG-48.

A computer program is developed for the enumeration of the isomers of polysubstituted compounds with b_1 substituents of the type 1, b_2 substituents of the type 2,..., b/sub n/ substituents of the type n. The procedure is illustrated with octahedral molecules containing 4 kinds of substituents (such as F, Cl, Br and I) and the isomers of polysubstituted non-rigid pentane with 4 kinds of substituents (such as F, Cl, Br and I) and the isomers of polysubstituted non-rigid pentane with 4 kinds of substituents. 33 references, 5 tables.

24969 **Computer representation of molecular surfaces.** Max, N.L. (Lawrence Livermore National Lab., CA). *Journal of Medical Systems;* **6**: No. 5, 485-499(1982). Contract W-7405-ENG-48.

From 15. Hawaii international conference on system sciences; Honolulu, HI, USA (Jan 1982).

This review article surveys recent work on computer representation of molecular surfaces. Several different algorithms are discussed for producing vector or raster drawings of space-filling models formed as the union of spheres. Other smoother surfaces are also considered.

24970 **Electronic excited state energy transfer, trapping by dimers and fluorescence quenching in concentrated dye solutions: picosecond transient grating experiments.** Lutz, D.R.; Nelson, K.A.; Gochanour, C.R.; Fayer, M.D. (Stanford Univ., CA). *Chemical Physics (Amsterdam);* **58**: 325-334(1981). Contract AT03-79ER10467.

Picosecond transient grating experiments are used to examine electronic excited state dynamics in concentrated dye solutions. A model based on radiationless excited state transport and trapping by dimers describes the phenomena responsible for fluorescence quenching. The trapping rate constant is found to have a cubic concentration dependence. Rhodamine 6G dimer lifetimes in glycerol and ethanol are 830 ps and $<$ 50 ps respectively. The difference arises due to the viscosity dependence of the dimer radiationless relaxation rate. 17 references, 7 figures.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 24985

24971 **(LBL—17367) Transport phenomena in improved electrochemical cell design for the production of magnesium. Final report.** Sadoway, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1983. Contract AC03-76SF00098. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010567.

Portions are illegible in microfiche products. Original copy available until stock is exhausted.

A laboratory scale electrolysis cell that is representative of industrial conditions has been constructed to permit visual observation within. Experiments were conducted using an electrolyte with the composition of 10% $MgCl_2$, 10% $CaCl_2$, 20% KCl, 60% NaCl, at the current densities of 5.55, 27.75, and 83.25 mA/cm^2. The effects of electrolyte contamination by 0.05% boron and 0.5% sulfur were studied by repeating the electrolyses with the addition of B_2O_3 and $MgSO_4$, respectively. The cathodic films deposited under these conditions were analyzed to determine how these impurities degrade cell performance. With electrolytes contaminated with either boron or sulfur, galvanostatic electrodeposition occurred at voltages too low to produce magnesium metal. Instead, what appeared to be nonmetallic deposits plated out on the cathode. These deposits consisted of magnesium compounds of the contaminants. Sodium levels high enough to be consistent with possible codeposition of sodium were detected.

24972 **Dye-loaded polymer electrodes. 2. Photoelectrochemical sensitization of croconate violet in polymer films.** Kamat, P.V.; Fox, M.A.; Fatiadi, A.J. (Univ. of Texas, Austin). *Journal of the American Chemical Society;* **106**: No. 5, 1191-1197(Mar 1984).

Enhanced sensitized photoelectrochemical effects are observed upon dispersal of croconate violet, an anionic pseudooxocarbon dye, in an adherent polymer coating (poly(4-vinylpyridine)) on a highly doped tin oxide electrode. Benzoquinone, functioning as a supersentizer, enhanced cathodic photocurrent generation by an order of magnitude. Characteristics of a photoelectrochemical cell employing such a dye-loaded polymer electrode have been investigated. Evidence is presented that dye-loaded polymer coating can mediate electron transfer between the electrode surface and dissolved redox couple.

4005 Photochemistry

REFER ALSO TO CITATION(S) 24648, 24650, 24943, 24952, 24965, 24967, 24972, 24995, 25090, 25118

24973 (BNL—51714, pp 7-11) **Rate constant measurements for the reactions OH + C_6H_6, OH + CH_4, and H + H_2O over 800-1400 K.** Madronieh, S.; Felder, W. (AeroChem Research Labs., Inc., Princeton, NJ). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The High Temperature Photochemistry (HTP) technique developed at AeroChem is being used to obtain kinetic data needed to understand performance and pollution formation processes of fossil fuel combustion devices and engines, over temperature ranges previously unattainable by a single photochemical technique. The HTP technique extends the useful range of the flash photolysis/resonance fluorescence method to about 1800 K. Rate coefficients obtained at high temperaturs fill the gap between direct low temperature measurements and high temperature data obtained in more complex reaction environments (such as flames and shock tubes). The measurements also provide an opportunity to evaluate the reliability of theoretical extrapolations over large temperature ranges, particularly for reactions which exhibit large deviations from Arrhenius behavior. The validity of the HTP technique over the 300 to 1700 K range was demonstrated in extensive measurements on the O/CH_4 reaction. Here the investigators present work in progress on rate coefficient measurements over the temperature range 800 to 1400 K for the reaction: (1) OH + C_6H^6 → Products; and (2) OH + CH_4 → Products. In addition, the rate coefficient for the reaction: H + H_3O → OH + H_2 was determined at several temperatures about 1100 K. Work on Reactions (1) and (2) has shown that this reaction must be considered in any kinetic study on OH above ca. 1000 Kif H_3O is used as a precursor. 11 references, 3 figures, 1 table.

24974 (BNL—51714, pp 12-15) **Absolute rate constants for the reaction of O(^{3}P) atoms with ethylene, propylene, and propylene-d6 over the temperature range 258 to 861K.** Perry, R.A. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24975 (BNL—51714, pp 16-20) **Kinetic study of radical-aromatic hydrocarbon reactions.** Ravishankara, A.R.; Nicovich, J.M. (Georgia Inst. of Tech., Atlanta). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Aromatic hydrocarbons undergo pyrolysis as well as reactions with free radicals such as OH($x^2\pi$), O(^{3}P), and H(^{2}S) to initiate and propagate combustion processes. Until recently radical-aromatic hydrocarbon reactions have received limited attention especially in understanding the reaction mechanisms as functions of temperature. Over the last few years the authors have been carrying out kinetic studies, over a wide temperature range, of the reactions of free radicals with aromatic hydrocarbons to obtain both absolute rate coefficient data and mechanistic information. Their stud-

ies of the kinetics of OH($x^2\pi$) and O(^{3}P) reactions with benzene, toluene, xylenes and their (partially or fully) deuterated analogs over wide temperature ranges are completed. The results have been published in four papers and are discussed briefly in this paper. 7 references, 4 figures.

24976 (BNL—51714, pp 26-29) **Rates and mechanisms of radical-molecule reactions: application of a novel laser technique.** Tully, F.P. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

A new, laser-based, chemical kinetics technique has been demonstrated in studies of the reactions of the hydroxyl radical with prototype hydocarbon fuel molecules. A schematic diagram of the experiment is presented. Following reaction initiation by 193-nm photolysis of N_2O in N_2O/H_2O/hydrocarbon/helium gas mixtures, time-resolved OH concentration profiles were measured as functions of hydrocarbon number density with a highly sensitive, quasi-cw, laser-induced fluorescence method. Absolute reaction rate coefficient data wre derived from these measurements. 5 references, 4 figures.

24977 (BNL—51714, pp 46-47) **Photoionization studies of gas-phase molecular complexes.** Grover, J.R. (Brookhaven National Lab., Upton, NY); White, M.G.; Walters, E.A. 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Photoionization excitation functions have been measured for molecular beams of the charge-transfer complexes 1,3-butadiene: SO_2, allene: SO_2, and trans-2-butene: SO_2 from λ = 350 A to 1520 A, using synchrotron radiation from the uv storage ring at the National Synchrotron Light Source at Brookhaven National Laboratory. These complexes are formed in nozzle expansions of mixtures of the olefin and sulfur dioxide. It was found that the excitation functions of the parent ions of the complexes are approximately the sums of the parent-ion excitation functions of their constituent molecules. Since these charge-transfer systems are only weakly bound, typically $\Delta H \sim$ -1 to -2 kcal/mole, such behavior is not unexpected. However, closer study reveals obvious differences from the simple sum of cross sections, and the investigation of these differences may offer a new avenue to a deeper understanding of such complexes. This prospect becomes especially interesting when the complex comprises part of the structure of a reaction hypersurface.

24978 (BNL—51714, pp 48) **Experiments with gas and liquid phase hydrocarbons on beamline U9A at the NSLS, and some characteristics of the beamline.** Preses, J.M.; Wickramaaratchi, M.A.; Holroyd, R.A.; Weston, R.E. Jr. (Brookhaven National Lab., Upton, NY). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24979 (BNL—51714, pp 48) **Photoionization studies of some simple unsaturated hydrocarbons and their clusters.** Ng, C.Y. (Iowa State Univ., Ames). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Photoionization studies of acetylene ethylene, propylene, and cyclopropane as well as their clusters have provided accurate thermochemical data for molecules and radicals which are important intermediates in combustion. The analysis of the photoionization spectra of the clusters has also provided significant insights into the ion-molecule reactions of these hydrocarbons. Important conclusions resulted from these studies are summarized. 15 references.

24980 (BNL—51714, pp 52-55) **Photodissociation of HF . C_2H_4, HCl . C_2H_4 and NeC_2H_4.** Janda, K.C.; Casassa, M.P.; Western, C.M. (California Inst. of Tech., Pasadena). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24981 (BNL—51714, pp 146-150) **Kinetics of elementary atomic and radical reactions.** Godon, R.J. (Univ. of Illinois, Chicago). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The reaction of oxygen atoms with hydrogen molecules is one of the most fundamental processes in combustion chemistry. There is currently a major theoretical effort to compute a chemically accurate potential energy surface for this reaction, and to develop reliable dynamical methods for computing the rate constant. This effort is hampered by a shortage of kinetic information which could be used to test the potential energy surface. The thermal rate constant by itself is insufficient to distinguish between several surfaces that have been published. To help resolve this problem the investigators have proposed to measure the intramolecular isotope effect for the pair of reactions: (1) O + HD → OH + D; and (2) O + HD → OD + H. This problem is studied in two stages. First the total rate constant k/sub H/ + k/sub D/ for reactions 1 and 2, as well as the rate constants k/sub H2/ and k/sub D2/ for the reactions O + H_2 → OH + H, O + D_2 → OD + D, are being determined by measuring the real-time decay of oxygen atoms in a flash photolysis - resonance fluorescence apparatus. A respresentative example of these measurements is shown graphically, and results are discussed. In the area of vibrational relaxation of highly excited molecules, a novel technique was developed for studying the competition between intramolecular and intermolecular relaxation of highly excited polyatomic molecules. A pulsed CO_2 laser is used to excite the molecule of interest (the donor molecule) in the presence of an excess of a relaxing partner (the receptor molecule). Real time measurement of IR emission from the receptor is used to monitor relaxation of the donor. A typical example of the IR fluorescence using SF_6 as the donor and N_2O as the receptor molecule is shown graphically and results are discussed. 6 references, 2 figures.

24982 (BNL—51714, pp 161-165) **Multiphoton photochemistry and spectroscopy.** Johnson, P.M. (State Univ. of New York, Stony Brook). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Experiments were performed to examine whether the oxidation products of benzene are the result of an ionic reaction or have a neutral precursor. Benzene and oxygen were expanded together in around 20 atm. of helium, resulting in large clusters containing up to around thirty benzene molecules and an intermediate number of oxygen molecues. A 193 nm pulse was used to irradiate the clusters initially. This photolytic pulse was followed by an ionizing probe pulse (249 nm) after a delay of up to 100 μsec. Even after this long time there is a substantial product containing oxygen, showing that either it or a precursor are stable neutral species. To date benzene is the only molecule found to undergo photo oxidation. Others tested include ethylene, ammonia and various substituted benzenes. There is something unique in the photochemistry of benzene at 193 nm which increases its reactivity. In order to better understand the electronic structure of the states of benzene which absorb in the near vacuum ultraviolet region the investigations have examined the corresponding three photon spectrum. The major transition seen is to the known 'A/sub 2u/^{3}Pxy Rydbery state, but there are additional peaks which do not appear in the one photon spectrum. These peaks are greatly enhanced in circularly polarized light. 2 figures, 1 table.

24983 (BNL—51714, pp 212-218) **Theoretical model for the photo-activated unimolecular dissociation of t-butyl hydroperoxide.** Chandler, D.W.; Miller, J.A. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

24984 **[1,5] sigmatropic hydrogen shift induced by high vibrational overtone excitation: the isomerization of 2-methylcyclopentadiene.** Jasinski, J.M.; Frisoli, J.K.; Moore, C.B. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **87**: No. 12, 2209-2213(9 Jun 1983).

Laser excitation of high CH stretching overtone transitions has been used to induce the isomerization of 2-methylcyclopentadiene to 1-methylcyclopentadiene. The reaction is a [1,5] sigmatropic hydrogen shift and therefore the reaction coordinate involves significant hydrogen atom motion. This provides a reasonable experimental test for the possibility that overtone excitation of CH stretching motions may lead to enhanced unimolecular reaction rates if there is strong coupling between the reaction coordinate and the nuclear motions which are excited by photon absorption. Values of the unimolecular reaction rate constant, k(E), have been deduced from photochemical quantum yields for excitation of the methylenic, methyl, and olefinic fourth CH stretching overtone transitions of 2-methylcyclopentadiene. No rate enhancement is observed for excitation of the methylenic transition compared to the methyl or olefinic transitions. The values of k(E) scale only with total energy and are in reasonable agreement with values calculated from RRKM theory.

24985 **Dc conductivity signals observed following pulsed photoionization of solutions of anthracene in dielectric liquids.** Sauer, M.C. Jr.; Trifunac, A.D.; Cooper, R.; Meisel, D. (Argonne National Lab., Il). *Chemical Physics Letters;* **92**: No. 2, 178-180(15 Oct 1982). Contract W-31-109-ENG-38.

Dc conductivity in several hydrocarbon liquids containing anthracene (2×10^{-6} M) and higher concentrations of efficient electron scavengers is measured following an 18 ns pulse of 248 nm light. With cyclohexane as the solvent, an initial conducivity signal, the origin of which is uncertain, decays over $\simeq 1$ μs and is initially more than an order of magnitude greater than the much longer lived free-ion signal. Strong effects of the solvent on this initial signal are observed. 2 figures.

24986 **Monosilylphosphine formation by rapid silylene insertion in the ir photochemistry of SiH_4-PH_3 mixtures.** Blazejowski, J.; Lampe, F.W. (Pennsylvania State Univ., University Park). *Journal of Photochemistry;* **20**: 9-16(1982). Contract AC02-76ER03416.

Monosilylphosphine is a major product of the ir multiphoton-induced decomposition of SiH_4-PH_3 mixtures carried out in such a way that only SiH_4 absorbs ir radiation from a pulsed CO_2 laser. The reaction forming monosilylphosphine is that of a very rapid insertion of silylene into a P-H bond of PH_3, a process occurring with a rate coefficient of 8.8×10^{-13} cm^3 molecule^{-1} s^{-1} at room temperature. Monosilylphosphine is not stable in the presence of large excesses of SiH_4 and PH_3 and decomposes to unidentified products at ambient temperature in a pseudo-first-order reaction. 4 figures.

24987 **Energy partitioning in the dissociation of cyanogen at 193 nm.** Halpern, J.B; Jackson, W.M. (Howard Univ., Washington, DC). *Journal of Physical Chemistry;* **86**: No. 6, 973-976(1982).

The quantum state distributions of CN radicals produced in the photodissociation of C_2N_2 at 193 nm have been measured. It has been found that the rotational distribution is the same for radicals formed in the $nu'' = 0$ and $nu'' = 1$ levels. This has been interpreted to mean that the rotational motion is decoupled during the dissociation, from the vibrational and translational motion of the fragments. The partitioning of the 6795 cm^{-1} of available energy between vibrational and translational motion in term has been found to be consistent with a simple statistical model. The observed rotational distribution was reproduced by assuming that there is no contribution to the angular momentum of CN other than the original angular momentum of the parent. 10 references, 4 figures.

24988 **ENDOR on photo-excited triplets randomly oriented in solid solution.** Kirste, B.; van Willigen, H. (Univ. of Massachusetts, Boston). *Chemical Physics Letters;* **92**: vp(1982). Contract AC02-81ER10911.

The preliminary results reported here establish the possibility of the use of ENDOR to measure hyperfine interactions in photo-excited triplet state molecules oriented in solid solutions. These systems are not amenable to single-crystal studies. The possibility exists for studying the medium effects on triplet structure, for example, in studies of porphyrins and related systems, where adduct formation and aggregation may have a significant effect on the electronic state. Short triplet lifetimes do not preclude the application of ENDOR. Spectra have been measured for zinc tetraphenylporphyrins $Zn(CN)_4TPP$ triplets in frozen toluene/ethanol at 5 K. The triplet lifetime of this system is of the same order as the electron spin relaxation time at temperatures of as much as 100 K. 3 figures.

4006 Radiation Chemistry

24989 (BNL—51714, pp 30-31) **Combustion chemistry using pulse radiolysis.** Jonah, C.D.; Zeglinski, P.; Mulac, W.A. (Argonne National Lab., IL). 1983. NTIS, PC A12/MF A01. (CONF-8305158—). Contract W-31-109-ENG-38.

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

We have begun by studying the reactions of Oh, one of the most important reactants in the combustion process. With our system we are able to measure from room temperature to 1000°C, a range which acts as a bridge between the previous flash photolysis measurements which could go to 600 to 700C and the shock tube measurements which are useable only at much higher temperatures. The first chemical system measured was $CO + OH \rightarrow CO_2 + H$. Rate of CO + OH as a function of temperature is presented graphically. Experiment was done at one atmosphere of argon and about 10 torr of water vapor. To gain further insight into the mechanism for this reaction, we are studying the reaction OD + CO to find the importance of the O-H(D) bond in the transition state. There have been only two studies published for this reaction, both at room temperature, one of which made measurements as a function of pressure. We have begun measuring the kinetics as a function of temperature. Preliminary data show that the OD rate is about 25% less than the OH rate at low temperatures but almost the same at high temperatures. This means that the breaking of the oxygen hydrogen bond is more important in the transition state of the mechanism which occurs at low temperatures. We have also studied the reaction rates of OH + methane. 1 figure.

24990 **Penetration of low-energy electrons in water.** LaVerne, J.A.; Mozumder, A. (Univ. of Notre Dame, IN). *Radiation Research;* **96**: No. 2, 219-234(Nov 1983).

The penetration of low-energy electrons in water has been calculated by combining a suitable stopping power theory with a theory of scattering. For the first part, a low-energy modification of Bethe's formula is adopted which uses the dipole oscillator distribution of Zeiss, Meath, MacDonald, and Dawson. The momentum transfer cross section is constructed from a Rutherford formula with a Moliere screening parameter modified to match various experimental data over a wide span of energy. Both elastic scattering and energy loss are included in a modified Lewis theory to determine the angular distribution of velocities and certain moments of the spatial distribution of an electron as it loses a definite amount of energy. The position distribution of the penetrating electron is calculated approximately using a random walk theory. The mean radial range and the mean penetration of the electron in the original direction of motion are compared to the mean electron path length and the root mean square penetration. Comparison with earlier calculations and application of the results to track structure in irradiated systems are indicated.

24991 **Determination of uranium-235/uranium-238 ratio in natural waters by Chelex 100 ion exchange and neutron activation analysis.** Gladney, E.S.; Peters, R.J.; Perrin, D.R. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: 976-977(1983).

Thermal neutron activation was used to determine the uranium isotope ratios in natural water. Impurities were removed from the water samples using a short ion-exchange column of Chelex 100, and the bromine present in the samples was then removed by standard hexone extraction. The method was applied to natural water samples from the Los Alamos area spiked with 250 μg of

uranium. Good accuracy and precision were achieved for all samples for the $^{235}U/^{238}U$ ratios. The overall precision of the measurement was in line with the +/-6% counting uncertainty for the 239 keV line.

24992 **Diffusion-controlled reactions involving steroid molecules with two isolated reactive groups.** Huddleston, R.K.; Mulac, W.A. (Argonne National Lab., IL). *Journal of Physical Chemistry;* 86: No. 13, 2279-2281(1982). Contract W-31-109-ENG-38.

Reactions of solvated electrons with steroid molecules having two electron accepting functional groups rigidly held ~ 10 A apart were studied in ethanol at room temperature. The measured rate constants show that these difunctional molecules are considerably less than twice as reactive as monofunctional model compounds, so that diffusion processes involving the two reaction sites are not independent. An approximate model based on diffusion in spheroidal geometry gives reasonable agreement with the results. 12 references, 1 figure, 2 tables.

4007 Radiochemistry And Nuclear Chemistry

24993 **F-to-HF reactions. VIII. Nonthermal complications for the $CHF_3/C_3F_6/C_2F_6$ moderated nuclear recoil system.** Mathis, C.A.; Gurvis, R.; Knickelbein, M.; Knierim, K.D.; Mo, S.H.; Root, J.W. (Univ. of California, Davis). *International Journal of Chemical Kinetics;* 11: 565-583(1982).

Results are reported from moderated nuclear recoil ^{18}F experiments with the 273 K $CHF_3/C_3F_6/C_2F_6$ system. Although the measurement sensitivity is only about +-12%, there is no evidence to support the occurrence of nonthermal F-to-HF reactions at 95 mol % C_2F_6 moderator concentration. 38 references, 4 figures, 3 tables.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 24637, 24655, 24951, 24952, 24954, 24955, 24956, 24973, 24974, 24975, 24976, 24979, 24989, 25117, 25118

24994 **(BNL—51714) Report on the combustion research contractors' meeting.** Klemm, R.B. (ed.). (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 257p. (CONF-8305158—). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84003881.

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Portions are illegible in microfiche products. Original copy available until stock is exhausted.

All papers and abstracts in this volume, (61 total), have been processed for inclusion in the Energy Data Base.

24995 (BNL—51714, pp 21-25) **Studies of combustion kinetics and mechanisms.** Gutman, D. (Illinois Inst. of Tech., Chicago). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The objective of the current research is to gain new quantitative knowledge of the kinetics and mechanisms of the reactions of polyatomic free radicals which are important in hydrocarbon combustion processes. A new method has been developed to generate polyatomic free radicals under controlled conditions which uses a pulsed CO_2-TEA laser to decompose suitable radical precursors in a tubular reactor. Their chemical reactions are monitored using a photoionization mass spectrometer capable of recording the time evolution of either reactants or products. During the past year research activities included five distinct studies, three of which were completed during the year and two of which are still in progress and are being performed to extend the capabilities of the experimental facility. Major efforts are being made to establish procedures to study recombination reactions and to study important combustion reactions at higher temperatures than are commonly accessible in flow reactor systems. The results from each investigation are summarized under the following titles: (1) kinetics of free radicals produced by infrared multiphoton-induced decomposition - formation of acetyl and chlorodifluoromethyl radicals and their reactions with nitrogen dioxide; (2) kinetics of the reaction of chlorine atoms wih vinylbromide and its use for measuring chlorine atom concentrations; (3) extent of the displacement route in the ractions of fluorine atoms with ethylene, vinylchloride,and vinylbromide; (4) reactions of polyatomic free radicals with molecular oxygen at elevated temperatures. 5 references, 3 figures, 1 table.

24996 (BNL—51714, pp 32-34) **Kinetics of some reactions of HCN at high temperature.** Hanson, R.K.; Bowman, C.T.; Szekely, A. (Stanford Univ., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The objective of the present research is to obtain high-temperature kinetic data for reactions involving HCN and the CN radical. These data are relevant to the formulation of reaction mechanisms for pollutant formation in flames. Reactions of interest include the thermal decomposition of HCN, the reactions of HCN with Cn, H, O and OH, the thermal decompositionof C_2N_2 and the reactions of CN with O and O_2. Incident shock waves are used to heat various gas mixtures containing HCN or C_2N_2, and spectroscopic diagnostics are employed to monitor time-histories of important species during reaction. The measured concentration profiles are compared with profiles calculated using a detailed kinetic model, thereby yielding data on relevant ate coefficient. 10 references.

24997 (BNL—51714, pp 35-38) **Shock-tube studies of important combustion-reaction steps involving methyl radicals.** Sulzmann, K.G.P. (Univ. of Califonia, La Jolla). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The aim of this research is twofold: (a) the development and use of shock-tube techniques for the rapid introduction of known combustion intermediate and radical concentrations into a chemical environment in which the individual interactions of these species with other combustion reactants, intermediates and products can be separated or, at least, enhanced so that meaningful rate data can be obtained for individual or important sub-groups of reaction paths relevant to hydrocarbon combustion; and (b) the development and use of in situ quantitative spectroscopic measurement techniques for the determination of required species concentration-time histories. As a first step in this direction, we study the fate and kinetics of the CH_3-radical during pyrolysis and its interactions with O_2 and O-atoms which are only partly understood qualitatively and quantitatively. The investigations are conducted behind reflected shock-waves in a glass shock-tube by using argon-diluted $CH_3CO_2CH_3$ and/or $(CH_3)_2$ as methyl radical donors, and oxidation reactions are initiated by admixing either O_2 or N_2O as an O-atom donor. Quantitative spectroscopic data are obtained by infrared emission by two photoelectric monochromators, by infrared HeXe-laser absorption at 3.508μ, by visible and ultraviolet emission with a 10-channel photoelectric multichromator, and/or by vacuum-ultraviolet absorption with a photoelectric monochromator. Results are discussed. 12 references.

24998 (BNL—51714, pp 39-42) **Pyrolyses of some gaseous fuels: kinetic pathways to soot formation.** Kern, R.D. (Univ. of New Orleans, LA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The thermal decompositons of toluene, benzene, allene, butadiene, and acetylene have been investigated over the same temperature and carbon atom density range employed in previous laser extinction studies in order to identify the sequence of chemical kinetic steps that comprise the preparticle soot formation process. The technique involves dynamic analysis of the gas in the reflected shock zone with a time-of-flight mass spectrometer operating at 30 microsecond intervals during a total observation time of typically 750 microseconds. The magnitude of the soot yield reported by earlier laser extinction workers along with their conclusion that the soot formation mechanism is dominated by original ring condensation steps (in the case of toluene and benzene) as opposed to ring

fragmentation steps followed by a polyacetylenic route to soot formation have been challenged. This challenge is based on several observations: (1) the primary products formed are C_2H_2, C_4H_2, and C_6H_2; (2) carbon atom balances obtained under dynamic sampling conditions are in the range of 70 to 95%; (3) there is no evidence for higher masses in the range of m/e 92 to 300 other than minor amounts of phenylacetylene (in the decomposition of benzene) and C_8H_2 (observed in minor amounts of higher temperatures). These facts lead to the conclusion that soot yields of 80% to 95% for toluene and benzene are much too high and should be reduced by at least a factor of 2 to 3. 27 references.

24999 (BNL—51714, pp 56-57) **Spectroscopy and structures of reactive intermediates.** Saykally, R.J. (Univ. of California, Berkeley). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25000 (BNL—51714, pp 77-79) **Theoretical studies of combustion dynamics.** Bowman, J.M. (Illinois Inst. of Tech., Chicago). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25001 (BNL—51714, pp 85-89) **Chemical kinetic modeling in combustion.** Miller, J.A.; Smooke, M.D.; Mitchell, R.E.; Green, R.M.; Kee, R.J. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The objectives of this research are twofold: (1) to develop chemical kinetic models which are capable of describing a wide variety of combustion phenomena (flames, detonations, explosions, etc.); (2) to identify key, or critical, elementary reactions for future experimental and theoretical investigation. The fulfillment of the latter objective, of course, is essential to fulfilling the former. The work described in this extended abstract concentrates on the investigators efforts in developing a comprehensive model for the oxidation of acetylene and on mechanisms for forming nitric oxide and converting it to molecular nitrogen in ammonia-oxygen glames. 2 references.

25002 (BNL—51714, pp 94-97) **Measurement of radical species concentrations and polycyclic aromatic hydrocarbons in flames by fluorescence and absorption using a tunable dye laser.** Salmon, J.T.; Lucht, R.P.; Ludington, P.D.; Sweeney, D.W.; Laurendeau, N.M. (Purdue Univ., Lafayette, IN). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The primary goal of this research is to develop quantitative laser fluorescence methods for measuring the concentrations of radical species and polycyclic aromatic hydrocarbons (PAH's) in flames. The accuracy of the fluorescence techniques is evaluated through comparison with independent diagnostic methods. The applicability of the techniques over a range of flame conditions is evaluated by performing the fluorescence experiments in a flat flame burner operated at a variety of flame pressures, temperatures and equivalence ratios. Recent progress has included: (1) extending the laser-saturated fluorescence (LSF) method for OH analysis to atmospheric pressure, methane-air flames under both clean and sooting conditions; (2) conducting LSF measurements of NH in a subatmospheric methane-nitrous oxide flame; (3) developing a technique for measuring the concentrations of PAH's in vapor state mixtures; and (4) detecting hydrogen atom fluorescence in a flame for the first time using a two-photon absorption process. 8 references.

25003 (BNL—51714, pp 98-99) **LDV-laser Raman investigations of aerothermochemical submodels.** Dibble, R.W.; Schefer, R.W. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25004 (BNL—51714, pp 102-104) **Two-dimensional fuel gas concentration measurements in a turbulent diffusion flame by Raman scattering.** Long, M.B.; Chang, R.K.; Chu, B.T. (Yale Univ., New Haven, CT). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25005 (BNL—51714, pp 105-108) **Resonant multiphoton optogalvanic detection of radicals in flames.** Goldsmith, J.E.M. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

We are using resonant multiphoton optogalvanic spectroscopy to observe atomic hydrogen and oxygen, two of the most important radicals in combustion chemistry, in atmospheric-pressure flames. With this technique, ground-state hydrogen or oxygen atoms are excited by resonant two-photon absorption, with subsequent single-photon ionizaton, and the ion-electron pairs are detected by electrodes mounted in or near the flame. We believe that this represents the first demonstration of direct in-situ optical detection of atomic hydrogen in a combustion environment, and that our detectivity for atomic oxygen in flames is substantially better than has been recently reported with other optical techniques. 4 figures.

25006 (BNL—51714, pp 113-116) **Laser pyrolysis/laser fluorescence system for combustion chemistry and diagnostics.** Crosley, D.R. (SRI International, Menlo Park, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—). Contract AC03-81ER10906.

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

A laser pyrolysis/laser fluorescence (LP/LF) system has been developed for the study of combustion chemistry at elevated temperatures, in the range 800 to 1500K. Measurements to date have been made to investigate the heating dynamics of the method, obtain vertification of its operation through a measurement of the OH + CH_4 reaction rate, measure the OH + C_2H_2 and OH + C_2H_6 reaction rates near 1200K, and measure the collisional quenching rate of the $A^2\Sigma^+$ state of OH with several partners at this same temperature. 9 references.

25007 (BNL—51714, pp 119-122) **Shock-tube pyrolysis of polycyclic aromatics: detection of soot precursors.** Bauer, S.H.; Zhang, L.M. (Cornell Univ., Ithaca, NY). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The objectives of these shock tube experiments are: (1) to determine the fragmentation patterns of a structurally related group of di- and tri-cyclic aromatic hydrocarbons (highly diluted in Ar) when shock heated to temperatures 1100 to 2100°K; (2) to develop minimal kinetic mechanisms for the sequence of reactions which account for the observed product distributions obtained when the shock heated samples were rapidly quenched by an expansion wave (test times is the back reflected region $\approx$ 500 to 700 μs); (3) to measure the relative levels of soot produced, and the growth rates, during the pyrolysis of these hydrocarbons; and (4) to formulate a semi-quantative nucleation-condensation scheme for the onset and growth rate of sooting. Although the program has not yet been fully implemented a number of interesting results which have been obtained for benzene, diphenyl, diphenylene, naphthalene, acenaphthene, acenaphthylene and mixtures of (acenaphthene + acetylene), and (acenaphthene + 2,2,4,4-tetramethylpentane) are discussed. In addition the He/NE transmission curves are analyzed. 4 figures.

25008 (BNL—51714, pp 123-127) **Theoretical studies of unimolecular and biomolecular reactions.** Brown, N.J. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The following investigations are briefly described in this report: (1) low pressure limit unimolecular dissociation of HO_2 re-

sulting from collisions with He; (2) microconical transition theory which includes molecular rotation and tunneling corrections; (3) classical dynamics study of the reaction $H_3 + OH \rightarrow H_2O + H$; (4) modelling study of flame inhibitors using HCl and HBr as inhibitors on combustion mixtures of hydrogen/oxygen/argon; and (5) modelling study of high temperature oxidation of H_3 on a platinum catalyst over a range of surface temperatures from 400 to 1070 K and equivalence ratios from 0.05 to 0.20. 6 references, 2 figures.

25009 (BNL—51714, pp 128-129) **Infrared absorption spectroscopy with color center lasers.** Curl, R.F. (Rice Univ., Houston, TX). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25010 (BNL—51714, pp 137-145) **Reaction mechanisms in combustion: formation of soot and polycyclic aromatic hydrocarbons.** Goddard, W.A. III. (California Inst. of Tech., pasadena). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The long term goal in this work is to elucidate the gas phase and heterogeneous processes involved in the formation of soot particles and polycyclic aromatic hydrocarbons (PCAH). This involves: (1) establishing likely candidates for the critical soot nuclei (that can subsequently grow to form the soot particles) by predicting the thermochemistry for various hydrocarbon radicals (and poly radicals) that may be formed by reactions of radicals such as CH_3 and HCC with polyacetylenes and related species. This involves eatablishment of the intermediates and products of the basic reaction steps along with parameters to estimate the rates and; (2) examining the dynamical and chemical processes involved in the growth of soot nuclei. The current emphasis is upon the heterogeneous processes (chemisorption onto the soot nucleus and dehydrogenation) involved in the growth of the soot nuclei processes involved in soot formation. The emphasis during this last year has been upon the development of methods adequate for treating the dynamics of the heterogeneous processes involved in growth of a soot particle. 4 figures.

25011 (BNL—51714, pp 151-153) **Study of combustion and flame processes initiated by IR laser induced multiple photon absorption.** Bhatnagar, R.; Duncanson, J.; Gericke, K.H.; Torres, L.; Guillory, W.A. (Univ. of Utah, Salt Lake City). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Studies in two major areas of chemical dynamics relating to the fundamental understanding of flame and combustion systems, namely state-selective chemical processes an energy transfer processes, have been performed. The phenomena of infrared multiple-photon absorption (IRMPA) and dissociation (IR MPD) have been used to produce excited state species and radical species in systems which simulate non-equilibrium processes which occur in flames and other combustion ssytems. A pulsed CO_2 laser is used to prepare vibrationally excited molecules or, via IR MPD, to produce radical species. The subsequent energy relaxation or reaction is followed by monitoring the spectrum or time evolution of reactant or product species via laser induced fluorescence from a tunable dye laser. Because ground electronic state molecules and radicals are still the predomiant species in flames, even at elevated temperatures, and those temperatures produce significant populations of vibrationally excited species, which may be more reactive than vibrationally cold molecules, the study of such species will further elucidate flame chemistry. We have studied the reaction rates of CH(Chi, $nu'' = 0,1$) with O_2, N_2 and also of NH_2(Chi, $nu_2 = 0,1$) + NO, CH_3NH_2, N_2H_4. The intramolecular and intermolecular energy transfer processes in glyoxal-methylfluoride and methylghyoxal-SF_6 have also been investigated. Results are discussed.

25012 (BNL—51714, pp 154-157) **Combustion gas spectroscopy using tunable lasers.** Hanson, R.K. (Stanford Univ., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

This research is concerned with the development and application of tunable laser techniques for the measurement of fundamental spectroscopic parameters (line and oscillator strengths, collision linewidths and fluorescence quenching factors) of combustion species. Laser sources utilized include a tunable cw infrared diode laser and a tunable cw visible/uv ring dye laser. Recent and current research includes the following projects: (a) high spectral resolution, tunable diode laser measurements of NO infrared spectroscopic parameters (band strength and collision linewidths) in a room temperature absorption cell, a flat flame burner, and a shock tube; (b) high spectral resolution, tunable laser measurements of HCN (3-micron band) infrared spectroscopic parameters (band strength and collision linewidths) in a room temperature absorption cell and a shock tube; (c) development of an advanced absorption lineshape model incorporating collision-narrowing (as well as broadening) effects, and its use in fitting high-resolution HCN absorption spectra (item (b) above); (d) calculations and measurements of high-temperature infrared absorption spectra for C_2H_2; (e) development of a fast-tuning, cw ring dye laser system (visible and intracavity-doubled uv) for measurements of spectroscopic parameters and species concentrations in shock heated and combustion flows. Project summaries are presented.

25013 (BNL—51714, pp 166-169) **Very high temperature pyrolysis of hydrocarbons.** Kiefer, J.H. (Univ. of Illinois, Chicago). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Recently two reactions of methyl radical have been proposed [4 to 6] whose presence could profoundly affect combustion in many hydrocarbon fuels. These are: (1) $2CH_3 \rightarrow C_2H_4 + H_2$ ($\Delta H°_{298} = -57.3$ kcal/mole) and (2) $2CH_3 \rightarrow C_2H_5 + H$ (rapidly followed by) (3) $C_2H_5 \rightarrow C_2H_4 + H$ ($\Delta H°_{298}$ (2 + 3) = + 47.0 kcal/mole). The rates suggested for these are quite large for $T > 1800$ K. The reactions mentioned above either are, or could be, of sufficient importance in combustion to mandate careful study. Our recent work has been aimed at estimating the rates of these reactions through laser-schlieren measurements on the shock-induced pyrolysis of ethane, 1, 3-butadiene, and 1-butene. Results are described briefly. 15 references.

25014 (BNL—51714, pp 170-175) **Theoretical studies on heterogeneous combustion.** Law, C.K. 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

In this paper, the investigators first present results on droplet combustion, in sub-sections 1 to 3. In sub-sections 4 and 5 the structure of diffusion flames are discussed, which is followed by results on some aspects of spray combustion in sub-section 6. In sub-section 7 they present their first attempt at incorporating somewhat more complex kinetic description in combustion modeling. Finally, their research activities on combustion fundamentals in general, and droplet combustion in particular, have resulted in several invited review papers. The nature of these reviews are discussed in sub-section 8.

25015 (BNL—51714, pp 186-189) **Dynamic light-scattering measurements of aerosol particulate diffusion.** King, G.B.; Sorensen, C.M.; Lester, T.W.; Merklin, J.F. (Kansas State Univ., Manhattan). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The diffusion constant is the key parameter for describing aerosol transport and coagulation. As such it is important for both the description of technologically important aerosols and for understanding fundamental processes in kinetic theory. We have recently measured the diffusion constant in three different aerosols, all of which have particle sizes comparable to the mean free path of the gas molecules. Two aerosols were flame generated soot aerosols, one in a slot burner CO/air diffusion flame doped with benzene, the other in a premixed ethylene/air flame. The soot particulate sizes were determined by static extinction/scattering methods to range from 70 to 300 A diameter. The third aerosol was generated by

evaporating suspensions of polystyrene microspheres, with diameters of 0.234 and 0.109 μm as specified by the manufacturer. Temperature in the flame aerosols was measured with an optical pyrometer, and gas viscosity and mean free path were calculated from this temperature and the known gas composition. These three systems combined to give diffusion constant data in the regime $1 < Kn < 100$. The diffusion constant of the aerosol particle as a function of Khudsen number is presented graphically. 7 references, 1 figure.

25016 (BNL—51714, pp 190-193) **Premixed turbulent combustion studies.** Robben, F.; Cheng, R.K.; Talbot, L. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The overall objective of this program is to investigate, primarily experimentally, the interaction between fluid mechanical turbulence and chemical reactions which together constitute the majority of combustion phenomena. The goal of this effort is to obtain an improved physical understanding of turbulent combustion, which can be used to devise better engineering of practical systems and to provide a more reliable database for the numerical modeling of turbulent combustion processes. Several diagnostic techniques based on the measurement of velocity by laser Doppler velocimetry (LDV) and density by Rayleigh scattering are used to measure statistical correlations in two idealized flow configurations. These statistical measurements are complemented by qualitative features of the development of the flame structures seen on high speed schlieren movies. The qualitative and quantitative results can be used to determined to what extent the observed flame structures are related to the measured correlations. The first experimental configuration which has been investigated is combustion embedded in a turbulent boundary layer over a strongly heated wall. The second experimental configuration studied consists of an unconfined rod-stabilized flame propagating in a turbulent flow. Results are discussed. 4 references, 2 figures.

25017 (BNL—51714, pp 194-197) **Quantitative laser induced fluorescence studies of flame chemistry.** Steinberg, M.; Schofield, K. (Univ. of California, Santa Barbara). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The present effort is directed to the characterization of lean (oxygen-rich) $H_2/O_2/N_2$ flames. Initially we have studied the behavior of sodium and monitored the influence of sulfur addition on the radical concentration levels. The major objective is to identify the operant flame chemistry of sulfur, nitrogen and carbon in these flames. It is generally accepted that almost all flame chemistry is controlled by the radicals H, OH and O which can overshoot equilibrium expectations and in some cases, reach concentration levels of a few percent of the major stable combustion products. The use of a large matrix of flames differing in composition and temperature is cruciial for resolving complex, coupled chemical systems. To date we have measurements of temperature profiles, laser induced fluorescence concentrations of OH profiles, and recorded the influence of SO_2 addition on these properties in ten lean flames. Also, by monitoring Na concentrations in these flames using saturated laser fluorescence, it has been possible, for the first time, to resolve fully the chemistry of sodium in oxidizing environments. 1 figure.

25018 (BNL—51714, pp 198-201) **Direct determination of atom and radical concentrations in thermal reactions of hydrocarbon and other gases.** Skinner, G.B.; Subba Rao, V. (Wright State Univ., Dayton, OH). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Our work has led so far to dependable methods for measuring H, D and O atom concentrations by resonance absorption spectroscopy, and we have applied the methods to making measurements of these atoms in several reaction systems of importance in combustion research. A number of studies have been published. These include: (1) measurements of H and D concentrations and rate constants of the pyrolysis of dilute mixtures of C_2H_6 and C_2D_6 in argon; (2) measurement of the rate constants for the reactions, O + H_2 →OH + H AND O + D_2 → OD + D; (3) measurements of O atom concentrations in shock heated H_2-O_2-Ar and D_2O_2-Ar mixtures; and (4) a set of thermodynamic calculations in the JANAF format for CH_3, CD_3 and several hydrocarbon molecules. Recently we have been measuring H and D atom concentrations in series of larger hydrocarbons. The first of these has been 2,2 dimethyl propane or neopentane. This molecule dissociates initially by loss of CH_3, $(CH_3)4C \rightarrow (CH_3)_3C + CH_3$ and the t-butyl radical dissociates rapidly mainly by the reaction, $(CH_3)_3C \rightarrow (CH_3)_2C = CH_2 + H$ so that the initial decomposition step can be deduced from the rate of appearance of H atoms, with only small corrections. Taking account of side reactions, the first-order rate constant for the first step in neopentane was found to be $K = 1.7 \times 10^{17} \exp(-84{,}000/RT)s^{-1}$. Other experiments include: pyrolysis of benzene-d_6 and mixtures of this with neopentane; pyrolysis using deuterated toluene; and pyrolysis of dilute mixtures of various propenes.

25019 (BNL—51714, pp 207-211) **Reactions of NH and NH_2 with NO.** Melius, C.F.; Binkley, J.S. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25020 (BNL—51714, pp 219-221) **Measurements of the structure of sooting laminar diffusion flames.** Flower, W.L.; Bowman, C.T. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25021 (BNL—51714, pp 227-229) **Collisional energy transfer in highly vibrationally excited HO_2 molecules.** Miller, J.A. (Sandia National Labs., Livermore, CA); Brown, N.J. 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Unimolecular reactions, both thermally and chemically activated, are extremely important in combustion (our primary motivation). The thermal dissociation and recombination of small free radicals (HO_2, HCO, NHO) are important chain branching and chain termination processes in flames. Addition-rearrangement/stabilization reactions (C_2H_2 + OH, NH_2 + NO) are most fruitfully regarded as chemically-activated unimolecular processes. In all these types of reactions, collisional energy transfer plays a critical role in determining reaction rate coefficients and/or product distributions. In order to gain a better understanding of collisional energy transfer in highly vibrationally excited molecules, classical trajectories are used in this work to study energy transfer in collisions of helium with HO_2 molecules excited near the dissociation limit. 1 reference.

25022 (BNL—51714, pp 230-232) **Relative soot yields of methyl and ring carbon in a toluene diffusion flame.** Schmieder, R.W. (Sandia National Labs., Livermore, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The relative probabilities of incorporating methyl and ring carbon atoms into soot when toluene is burned in a diffusion flame have been measured using methyl-carbon-14 labelled toluene. The results show that the methyl carbon is less likely to end up in the soot than the ring carbons, which in turn supports models of toluene combustion in which the methyl side chain is preferentially oxidized to final gas products (CO,CO_2). 4 references.

25023 (BNL—51714, pp 236-240) **Computation of turbulent reacting flows: comparison of various mixing/chemistry interaction models.** Wormeck, J.J. (Dynamics Technology, Inc., Torrance, CA). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

This research program is an analytical and computational study to compare various mixing/chemistry interaction models for turbulent combustion. Four different models are considered: (1) chemical equilibrium; (2) finite-rate chemistry utilizing mean values; (3) probability density function (PDF) approach with infinite-rate chemistry; and (4) a novel technique developed in this paper, in which the turbulent-chemistry correlations are modeled by PDF and then solved by a finite-difference procedure. The chemistry correlations result from Reynolds decomposing the thermochemical equations and can be combined into a contact index for each reaction which may be viewed as correcting the reaction rate when the rate is evaluated with mean values of temperature and concentrations. Use of these contact indexes in model will extend the model to finite-rate micro-mixing. Thus, the new model can describe chemistry and micro-mixing when both rates are finite. All of these combustion models are fully coupled to a computation of two-dimensional fluid flow and the results are compared to experiment. To fully model turbulent combustion, three finite-rate processes must be modeled: macro-mixing; micro-mixing; and chemical reactions. 1 figure, 1 table.

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4201 General Engineering

25024 **(DOE/ER/13163—2) Mechanical interactions of rough surfaces. Progress report, January 1-April 1, 1984.** McCool, J.I. (SKF Technology Services, King of Prussia, PA (USA)). Apr 1984. Contract AC02-84ER13163. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008589.

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Rig modifications currently underway are briefly reviewed. An evaluation of the computerized roughness processing system performed using a precision sinusoidal specimen is described in some detail. An expository paper on the elastic contact of rough surfaces has been drafted and is briefly described herein. The text of a reply to a discussion of a recently presented paper is given.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 24624, 24762, 24763, 24926, 24932, 25113

25025 **(BDX—613-3062) Initial insights on robotics.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Apr 1984. Contract AC04-76DP00613. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010768.

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The implementation of three production robot systems and concurrent development activities on other potential applications have provided some significant insights into the state-of-the-art of robotics. Observations discussed include the impact of using state-of-the-art robots versus proven technology, the impact of part changeover, application choices, robot and vision characteristics, safety, and planning for applications.

25026 (EPRI-CS—3158, pp 3.11-3.19) **Dynamic instability of seals and bearings.** Bently, D.E. (Bently Nevada Corp., Minden, NV). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

The instabilities of centrifugal pumps as well as other rotating machines present major problems to both users and manufacturers of these machines. The malfunction mechanism is identified as a forward circular whip of the rotor at the first balance resonance speed - except oil whirl, which is forward circular but occurs below critical at a fixed rotation speed. This malfunction is created by various mechanisms such as oil whip in bearings, steam whip in steam turbines, internal friction whip in all machine types, aerodynamic cross-coupling whip in compressors, and pumping whip in pumps. The nature of these mechanisms is that they aid and abet each other, so that a machine may become unstable due to any combination of them. The classical hydrodynamic, mechanical, and aerodynamic treatment of forward whip instabilities across the last 80 years has not yielded very much in the way of realistic measurable and predictable parameters. The purpose of this paper is to show a means of testing a rotor system, to present the observed measurement values, to show that all rotor systems are closed-loop control systems (servomechanisms) by their fundamental nature, and to show newly observed basic interlocking relationships of the rotor system parameters.

25027 (EPRI-CS—3158, pp 3.20-3.35) **Testing of turbulent seals for rotordynamic coefficients.** Childs, D.W. (Texas A & M Univ., College Station); Dressman, J.B. Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

A facility has been developed for dynamic testing of straight and convergent-tapered seals with the capability of measuring the radial and tangential force components which result from a circular centered orbit. The test apparatus causes the seal journal to execute small-eccentricity centered circular orbits within its clearance circle. Dynamic measurements are made and recorded of the seal-displacement-vector components, and of the pressure field. The pressure field is integrated to yield seal tangential and radial reaction-force components. Representative test data are provided and discussed for straight seals.

25028 (EPRI-CS—3158, pp 3.36-3.49) **Some observations on feed pump vibrations.** Gopalakrishnan, S.; Husmann, J. (Borg-Warner Corp., City of Commerce, CA). Jul 1983. NTIS, PC A17/MF A01. (CONF-8206209—).

From EPRI symposium on the state of the art of power plant feed pumps; Cherry Hill, NJ, USA (2 Jun 1982).

Vibration problems occurring in centrifugal pumps are often attributed to operation at or near a critical speed. In this paper it is shown that the presence of liquid in close clearance running fits raises the critical speed significantly. In some cases, the critical speed may be completely eliminated. Therefore, investigation into vibration troubles should in many instances be directed towards phenomena other than the critical speed of the rotating element; e.g., mounted system resonant frequencies. This paper contains some case histories wherein vibration problems were solved by attending to these other phenomena rather than by altering the pump rotating element.

25029 **(LA-UR—84-910) Intelligent optical design program.** Bohachevsky, I.O.; Viswanathan, V.K.; Woodfin, G. (Los Alamos National Lab., NM (USA)). 4 May 1984. Contract W-7405-ENG-36. 15p. (CONF-8404124—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010071.

From SPIE technical symposium; Arlington, VA, USA (29 Apr 1984).

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Described is a general approach to the development of computer programs capable of designing image-forming optical systems without human intervention and of improving their performance with repeated attempts. The approach utilizes two ideas: (1) interpretation of technical design as a mapping in the configuration space of technical characteristics and (2) development of an intelligent routine that recognizes global optima. Examples of lens systems designed and used in the development of the general approach are presented, current status of the project is summarized, and plans for the future efforts are indicated.

25030 **Low-temperature magnetic refrigerator.** Barclay, J.A. (to to Dept. of Energy). US Patent Application 6-498,434. 26 May 1983. 15p. Contract W-7405-ENG-36.

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The invention relates to magnetic refrigeration and more particularly to low temperature refrigeration between about 4 and about 20 K, with an apparatus and method utilizing a belt of magnetic material passed in and out of a magnetic field with heat exchangers within and outside the field operably disposed to accomplish refrigeration.

4203 Lasers

REFER ALSO TO CITATION(S) 24970

25031 (LA-UR—84-635) Efficient forward conversion in a Raman generator. Carlsten, J.L.; Telle, J.M.; Wenzel, R.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 14p. (CONF-840629—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007466.

From 13. international quantum electronics conference; Anaheim, CA, USA (18 Jun 1984).

Stimulated Raman scattering of an XeCl laser at 308 nm in a high pressure H_2 cell shows anomalously high conversion into first Stokes (S1) when a pumping geometry with a Fresnel number near unity is used. Specifically a quantum efficiency of 88% is obtained into S1. Comparison with a plane-wave model indicates that a theory including diffraction and 4-wave mixing may be necessary to understand the anomalous holdoff of the second Stokes component. 10 references.

25032 (UCRL—53525) Bond graph time simulations using extracted modal parameters from the Nova spaceframe. Pastrnak, J.W. (Lawrence Livermore National Lab., CA (USA)). 27 Jan 1984. Contract W-7405-ENG-48. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010918.

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Bond graphs are a convenient way of representing the energy exchange, storage, and dissipation mechanisms for interacting energetic systems. One major advantage for using bond graphs to model physical systems is that the governing state equations are always in first order form and can usually be integrated fairly easily with today's modern digital computers. This thesis demonstrates a procedure for simulating the dynamics of a large inherently distributed structure using bond graph modeling techniques and incorporating a limited number of normal modes previously measured from an experimental modal analysis.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 24774, 25123

25033 (ISU-ERI-AMES—84221) Bibliography on augmentation of convective heat and mass transfer-II. Bergles, A.E.; Nirmalan, V.; Junkhan, G.H.; Webb, R.L. (Iowa State Univ. of Science and Technology, Ames (USA). Heat Transfer Lab.). Dec 1983. Contract FG07-81ID12222. 316p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84010848.

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Heat transfer augmentation has developed into a major specialty area in heat transfer research and development. This report presents and updated bibliography of world literature on augmentation. The literature is classified into passive augmentation techniques, which require no external power, and active techniques, which do require external power. The fifteen techniques are grouped in terms of their applications to the various modes of heat transfer. Mass transfer is included for completeness. Key words are included with each citation for technique/mode identification. The total number of publications cited is 3045, including 135 surveys of various techniques and 86 papers on performance evaluation of passive techniques. Patents are not included, as they are the subject of a separate bibliographic report.

4205 Materials Testing

REFER ALSO TO CITATION(S) 24907, 24908

25034 Detection of flaws below curved surfaces. Elsley, R.K.; Addison, R.C.; Graham, L.J. (Rockwell International Science Center, 1049 Camino Dos Rios, Thousand Oaks, CA 91360). pp 113-128 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A measurement model has been developed to describe ultrasonic measurements made with circular piston transducers in parts with flat or cylindrically curved surfaces. The model includes noise terms to describe electrical noise, scatterer noise and echo noise as well as effects of attenuation, diffraction and Fresnel loss. An experimental procedure for calibrating the noise terms of the model was developed. Experimental measurements were made on a set of known flaws located beneath a cylindrically curved surface. The model was verified by using it to correct the experimental measurements to obtain the absolute scattering amplitude of the flaws. For longitudinal wave propagation within the part, the derived scattering amplitudes were consistent with predictions at internal angles of less than 30°. At larger angles, focusing and aberrations caused a lack of agreement; the model needs further refinement in this case. For shear waves, it was found that the frequency for optimum flaw detection in the presence of material noise is lower than that for longitudinal waves; lower frequency measurements are currently in progress. The measurement model was then used to make preliminary predictions of the best experimental measurement technique for the detection of cracks located under cylindrically curved surfaces.

25035 Eddy-current probe design. Kincaid, T.G.; McCary, R.O. (Corporate Research and Development, General Electric Company, Schenectady, NY 12345). pp 171-188 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes theoretical and experimental work directed toward finding the optimum probe dimensions and operating frequency for eddy current detection of half-penny surface cracks in nonmagnetic conducting materials. The study applies to probes which excite an approximately uniform spatial field over the length of the crack at the surface of the material. In practical terms, this means that the probe is not smaller than the crack length in any of its critical dimensions. The optimization of a simple coil probe is first analyzed in detail. It is shown that signal-to-noise ratio and lift-off discrimination are maximized by a pancake coil with mean radius not greater than the crack length, operated at a frequency which gives a skin depth equal to the crack depth. The results obtained for the simple coil are then used as a basis for discussion of the design of coils with ferrite cores and shields, and for the design of recording head type probes.

25036 Development of an eddy current inspection technique for sleeved engine disk bolt holes. Palanisamy, R.; Lakin, K.M. (Ames Laboratory, USDOE Iowa State Univ., Ames, IA 50011). pp 205-224 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Recent research programs have concentrated mainly on developing techniques to characterize surface breaking cracks and very little has been done towards characterizing subsurface flaws in conducting materials. Presented in this paper are the results of some initial theoretical work aimed at the development of a reliable eddy current technique to detect and characterize defects in engine disk

bolt holes under a 0.05" stainless steel sleeve. The change in impedance of an absolute eddy current coil with and without ferrite core, and the distribution of eddy currents around a second layer crack with and without a thin insulating film between the two conducting layers have been predicted numerically. The overall system development goals and methods to accomplish them are outlined briefly.

25037 **Analysis and design of eddy-current measurement systems.** Bahl, A.J.; Cooley, D.W. (SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025). pp 225-244 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The objective of this paper is to develop a statistical detection model for an eddy-current system, and to use the model to calculate the probability of detection as a function of the probability of false alarm, for the purpose of determining the optimality of the particular system. The methodology involved in computing the statistical detection characteristics of the eddy-current system is illustrated, and requires knowledge of the flaw distribution in size, orientation, and location, flaw voltage as a function of the former, the probability distribution for probe motion, the clutter voltage as a function of probe motion, and the probability distributions for surface roughness, materials variations, and electronic noise. A typical eddy-current system is shown, and the geometry of the air coil is given.

25038 **An analysis of electromagnetic acoustic transducer arrays for nondestructive evaluation of thick metal sections and weldments.** Fortunko, C.M.; Schramm, R.E. (Fracture and Deformation Division, National Bureau of Standards, Boulder, CO 80303). pp 283-308 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A new type of electromagnetic-acoustic transducer (EMAT) has been developed that may be particularly suitable for use as an element of ultrasonic arrays. The new transducer can generate and receive compact ultrasonic pulses that exhibit a component of polarization parallel to the free surface. In the plane of symmetry that is normal to the free surface and bisects the EMAT (the sagittal plane), the ultrasonic signals generated by the new transducer are SH waves. In addition, the new transducer can efficiently receive ultrasonic signals from a very wide range of direction in the sagittal plane. This property is required to realize very long synthetic aperture lengths, which are needed to maximize the transverse resolution of ultrasonic inspection systems. The focusing performance of different linear synthetic array configurations using the new EMAT is compared analytically with that of a linear end-fire system using periodic-permanent-magnet (PPM) EMATs that have been used in the past in weld inspection. The advantages and inherent limitations of such systems are examined using analytical and numerical methods. Particular emphasis is placed on the analysis of arrays that can be focused obliquely with respect to the free surface and the potential usefulness of such systems in weld inspection.

25039 **Effects of crack closure on ultrasonic transmission.** Thompson, R.B.; Buck, O.; Schmerr, L.W.; Skillings, B.J.; Zachary, L.W. (Ames Laboratory-USDOE, Iowa State University, Ames, IA 50011). pp 325-344 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Ultrasonic waves are attenuated as they propagate past the tip of a crack due to the reflection of the energy at the crack face and diffraction at the crack tip. Crack closure modifies the situation since partial transmission can occur at points along the crack face where asperities come in contact. This phenomenon is important in defining the ability to nondestructively detect closed cracks and in developing a more detailed understanding of the closure phenomenon itself. Modified compact tension specimens were used to investigate the effects of partial crack closure on focussed, through transmission ultrasonic signals. Data obtained from fatigue cracks in 7075-T651 Al provides evidence for a gradual transition from a fully closed crack condition at the crack tip to an essentially fully open condition at a distance of a few mm from the tip, with additional localized contact along the length of the crack. This interpretation of the data was aided by a two-dimensional, quasi-static model for ultrasonic interaction with a partially contacting interface. The model relates width and separation of asperity contacts to the frequency dependence of the ultrasonic reflection and transmission. These measurements were supplemented by tests in which water infiltrated into the crack opening. The frequency spectra of the ultrasonic transmitted signals for this case were used to estimate the average COD at various points along the crack length.

25040 **Simulation of closure: Effects on crack detection probability and stress distributions.** Buck, O.; Reed, L.K.; Skillings, B.J. (Ames Laboratory, Iowa State University, Ames, IA 50011). pp 345-352 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

It is well known that partial contact of two rough crack surfaces will lead to transmission of an acoustic signal across the crack, thus giving rise to a reduced probability of detection (POD). To explore the effects and consequences of such partial contact, impression experiments--using small spheres--have been performed to determine the effects of contact area on the amplitude transmitted. The results have been compared with a theory described elsewhere in these proceedings. Based on the experimental results it will be speculated that the residual stress field responsible for the crack closure may be calculated based on a determination of the size and separation of the contact areas.

25041 **Detection of closed internal fatigue cracks.** Tittmann, B.R.; Ahlberg, L.; Buck, O.; Cohen-Tenoudji, F.; Quentin, G. (Rockwell International Science Center, Thousand Oaks, CA). pp 353-366 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper reviews some recent work on the detection and sizing of closed internal fatigue cracks by ultrasonic techniques. Major emphasis is put on the diffraction of shear waves at the crack tip. Both fully open as well as partially closed cracks were considered. The effect of crack closure stress on backscattered (pulse-echo) shear waves was studied with the aid of an Al compact tension specimen. Noticeable changes with crack closure stress were documented for the structure of both the time-domain and frequency-domain representations. The techniques acquired with this specimen were applied to the study of a 50 μm radius semicircular crack internal to a diffusion bonded Ti-alloy plate. Improved signal processing techniques were employed to detect the crack and to distinguish it from an artificial surface crack. The probability of detection, assumed to be proportional to the signal-to-noise ratio, was measured as a function of crack interrogation angle and crack closure stress to provide data on optimum probability for detection and sizing.

25042 **Wave scattering by obstacles in joined fluid-solid half spaces.** Varadan, V.V.; Pillai, T.A.K.; Varadan, V.K. (Wave Propagation Group, Dept. of Eng. Mechanics, The Ohio State Univ., Columbus, OH 43210). pp 777-794 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper is concerned with a theoretical study of a near surface flaw in an immersion tank experiment. The formulation is

based on the use of the T-matrix to characterize the scatter response and transmission and reflection matrices to characterize the effect of the interface. Expressions are derived for the pressure field in the fluid at distances far from the solid-fluid interface. The numerical procedure is described and results are presented for spherical cavities and inclusions embedded at various depths below the interface. The frequency spectra are compared with one term expansion of multiple scattering process, and with the single scattering approximation. Calculations for normal and oblique incidence are in general agreement with the experimental observations. These conclusions will be of use in the design of experiments for NDE of subsurface flaws.

25043 **Comparison of matrix methods for elastic wave scattering problems.** Tsao, S.J.; Varadan, V.K.; Varadan, V.V. (Wave Propagation Group, Dept. of Eng. Mechanics, The Ohio State Univ., Columbus, OH 43210). pp 441-458 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This article briefly describes the T-matrix method and the MOOT (method of optimal truncation) of elastic wave scattering as they apply to A-D, SH- wave problems as well as 3-D elastic wave problems. Two methods are compared for scattering by elliptical cylinders as well as oblate spheroids of various eccentricity as a function of frequency. Convergence, and symmetry of the scattering cross section are also compared for ellipses and spheroidal cavities of different aspect ratios. Both the T-matrix approach and the MOOT were programmed on an AMDHL 470 computer using double precision arithmetic. Although the T-matrix method and MOOT are not always in agreement, it is in no way implied that any of the published results using MOOT are in error.

25044 **Acoustic emission linear pulse holography.** Collins, H.D.; Busse, L.J.; Lemon, D.K. (Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352). pp 503-516 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC06-76RL01830.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes the emission linear pulse holography which produces a chronological linear holographic image of a flaw by utilizing the acoustic energy emitted during crack growth. A thirty two point sampling array is used to construct phase-only linear holograms of simulated acoustic emission sources on large metal plates. The concept behind the AE linear pulse holography is illustrated, and a block diagram of a data acquisition system to implement the concept is given. Array element spacing, synthetic frequency criteria, and lateral depth resolution are specified. A reference timing transducer positioned between the array and the inspection zone and which inititates the time-of-flight measurements is described. The results graphically illustrate the technique using a one-dimensional FFT computer algorithm (ie. linear backward wave) for an AE image reconstruction.

25045 **Analytic diffraction corrections to ultrasonic scattering measurements.** Thompson, R.B.; Gray, T.A. (Ames Laboratory-USDOE, Iowa State Univ., Ames, IA 50011). pp 567-586 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

In ultrasonic measurements, the frequency and angular dependences of the scattering amplitude are convolved with those of transmitting and receiving transducers and the propagation through liquid-solid and solid-liquid interfaces. This paper presents a set of approximate corrections to these effects. A typical experimental configuration is analyzed and a set of approximate corrections which can be used to relate observable experimental signals to the absolute scattering theory are developed. Analytical models for radiation of an elliptical piston into a fluid, propagation of a circular beam through a liquid-solid interface, focussing of a spherical beam in a fluid, and propagation of a circular beam through a cylindrical liquid-solid interface are studied. In this way an approximate measurement model is developed which relates the pulse-echo signal measured by circular transducer in an immersion configuration to a scattering amplitude which would characterize the same flaw in an unbounded elastic medium. The diffraction correction factor is an essential feature of the model.

25046 **Numerical calculations of ultrasonic fields.** Johnson, J.A. (NDE Eng., EG & G Idaho, Inc., Idaho Falls, ID 83415). pp 601-610 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC07-76ID01570.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes the preliminary results of a code for calculating ultrasonic fields developed by revising the thermal hydraulics-structures code STEALTH applied to a realistic experimental environment. The configuration of the code is sketched and the velocity vectors in the region just below the crack are given. Several gray scale plots are exhibited and show the pressure variation in the region of the grid around the simulated crack, as weak, scattered longitudinal, and reflected longitudinal waves appear. The code has correctly calculated the mode conversion at the water-steel interface and has been previously shown to correctly predict transducer fields.

25047 **Elastic wave scattering from rough surfaces and cracks.** Ayter, S.; Auld, B.A. (Edward L. Ginzton Laboratory, Stanford Univ., Stanford, CA 94305). pp 611-624 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper investigated scattering from smooth cracks to rederive the "flash point" concept based on which an inversion procedure is proposed for obtaining the characteristic function of the crack, which gives information on crack roughness, dimension, and shape. In this paper the method for smooth cracks is extended to the rough crack scattering and the effects measured via simple Fourier transform relations. The scattering formula due to Auld and Kino used to calculate the scattering coefficient is given, and the geometry of general scattering is outlined. Scattering from smooth cracks in the 2-D and in the 3-D case are determined. The inversion scheme is applied, and its weaknesses discussed. The perturbation analysis used by Krekkovishkikh to calculate the Rayleigh wave attenuation due to surface roughness is used to model the rough cracks. The inversion algorithm is then applied to give the sum of smooth crack characteristic function, and the roughness contribution.

25048 **A reliability-confidence methodology for complex systems.** Bevensee, R.M. (Lawrence Livermore National Laboratory, Livermore, CA 94550). pp 635-642 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A formalism for analyzing the reliability R of an interval for system probability of failure and its confidence C from the component R-C intervals is outlined. In the general formalism one must obtain the network representation of the system with path failure probabilities indicated, derive by an algorithm a representation of the system by disjoint paths, declare an R-reliable interval for each component probability of failure, and derive the confidence in that interval. This formalism is developed with reference to aircraft engine component retirement-for-cause. The network diagram consists of paths for various rotor components. R-C intervals for the path state probabilities and for the system probability failures are

calculated. The final solution involves sums and products of a number of integrals which can be quickly evaluated by an integration logorithm.

25049 **Application of Fourier elastodynamics to direct and inverse problems for the scattering of elastic waves from flaws near surfaces.** Richardson, J.M.; Fertig, K.W. Jr. (Rockwell International Science Center, Thousand Oaks, CA 91360). pp 747-776 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

In order to inspect flaws which lie too close to the surface a Fourier elastodynamic formalism is proposed which enables one to decompose the elastodynamic system into separately charterizable parts by means of planes perpendicular to the z-axis. The process can be represented by a generalized transfer function relating the near-field scattered waves to the waves incident on a slab of material containing the flaw. The Fourier elastodynamics are applied to the characterization of the total scattering process involving a flaw at various distances from a plastic-water interface. An abbreviated discussion of Fourier elastodynamics is presented, and the results specialized to the case of spherical voids and inclusions bear an interface. Finally, the computational results for several ranges of temporal frequency and for a sequence of values of the distance from the flaw center to the interface are discussed.

25050 **Simulation of a multitransducer ultrasonic dome device for nondestructive evaluation.** Davison, M.E.; DeFacio, B. (Ames Lab., IA). pp 1241-1252 of Modeling and simulation. Vol. 12, Part 4. General modeling and simulation. Vogt, W.G.; Mickle, M.H. (eds.). Research Triangle Park, NC; Instrument Society of America (1981). (CONF-810477—Vol.4). Contract W-7405-ENG-82.

From 12. modeling and simulation conference; Pittsburgh, PA, USA (30 Apr 1981).

An applied inverse problem in nondestructive evaluation is discussed. An n-transducer dome with elastic-wave transducers of different characteristics is studied, including both noise and the effects of ill-posedness. In the case of weak scattering from homogeneous spherical flaws, an example using the Fisher information matrix is given. The optimal design problem for the ultrasonic dome is formulated.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 24637

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 25056

25051 **Circuit breaker lock out assembly.** Gordy, W.T. (to to Dept. of Energy). US Patent Application 6-495,889. 18 May 1983. 14p. Contract AC09-76SR00001.

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A lock out assembly for a circuit breaker which consists of a generally step-shaped unitary base with an aperture in the small portion of the step-shaped base and a roughly S shaped retaining pin which loops through the large portion of the step-shaped base. The lock out assembly is adapted to fit over a circuit breaker with the handle switch projecting through the aperture, and the retaining pin projecting into an opening of the handle switch, preventing removal.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 24889

4220 Underground Engineering

REFER ALSO TO CITATION(S) 24608

43 PARTICLE ACCELERATORS

4302 Beam Dynamics, Field Calculations, And Ion Optics

25052 **(FERMILAB/TM—1253) Automatic beam centering at the SSC interaction regions.** Joestlein, H. (Fermi National Accelerator Lab., Batavia, IL (USA)). 20 Mar 1984. Contract AC02-76CH03000. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010710.

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In the SSC interaction regions, the two colliding beams, each only a few microns in size, will have to be centered and maintained in good alignment over many hours, in order to provide the maximum possible luminosity and to minimize off-center beam-beam focussing effects. It is unlikely that sufficiently good alignment can be achieved without some kind of active feedback system, based on the beam-beam interaction rate. This memo describes such a system. In the proposed scheme, one of the beams is moved continuously and in a circular fashion about its mean transverse position. The radius of this motion is approximately 0.01 of the rms beam size at the interaction point. The motion is achieved with two sets of crossed high frequency dipole magnets, one on each side of the interaction region, suitably phased. As a consequence of this motion, the beam-beam interaction rate is modulated in synchronism with the beam motion when the beams are not centered on one another. The amplitude and phase of this modulation yields information on the magnitude and direction of the misalignment between the beams, allowing continuous display and automatic correction of any misalignment.

4303 Auxiliaries And Components

25053 **(SLAC/AP—13) Analytic solution for the problem of gridded gap-electron flow interaction.** Kheifets, S.; Yu, S.; Jaeger, J. (Stanford Linear Accelerator Center, CA (USA)). Jan 1984. Contract AC03-76SF00515. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008975.

The present study is motivated by the modelling of high-power klystrons. The two basic components of a Klystron are the resonant cavities and the drift spaces. This paper addresses only the first of these two components. Modelling of the drift spaces is deferred to future work. The formulation is not restricted to Klystron modelling, but is applicable to any problem involving the interaction of an electron beam with a resonant cavity. While the theory of Klystrons has been worked out in detail in the small signal limit, the problem remains largely unsolved when the signals are large. In particular, the hydrodynamic models of electron beams used to derive the small signal theories fail when particle trajectories cross each other. In this paper, we employ a Vlasov description of the electron beam to study the Klystron problem. In the Vlasov formulation we follow the evolution of the electron distribution function in phase-space. The general framework can naturally accommodate particle crossing, and the beam dynamics is accurately described even when the signals are large.

4304 Storage Rings

REFER ALSO TO CITATION(S) 25127

44 INSTRUMENTATION

4401 Radiation Instrumentation

25054 **(LA—10009-M) Plutonium nitrate bottle counter manual.** Menlove, H.O.; Adams, E.L.; Holbrooks, O.R. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 24p. (ISPO—203). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011020.

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A neutron coincidence counter has been designed for plutonium nitrate assay in large storage bottles. This assay system can be used in the reprocessing plant or in the nitrate-to-oxide conversion facility. The system is based on the family of neutron detectors similar to the high-level neutron coincidence counter. This manual describes the system and gives performance and calibration parameters for typical applications. 4 references, 11 figures, 9 tables.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 24932

25055 **(LA-UR—84-984) Optimal object and edge localization in the presence of correlated noise.** Hanson, K.M. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 10p. (CONF-840278—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009971.

From SPIE conference; San Diego, CA, USA (26 Feb 1984).

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The ideal observer for the task of object localization in the presence of correlated noise is implemented by means of the minimum chi-squared method, which is equivalent to the maximum likelihood method when the noise is additive and normally distributed. The prewhitening approach is explored in which the noise in the data is made uncorrelated by filtering the data with the filter S/sup -1/2/, where S is the noise power spectrum. The location of the object is then found by fitting a model of the object to the prewhitened data. A measure of the goodness of fit is proposed that is based upon the serial correlation in the prewhitened residuals, the difference between the data and the fit. These concepts are demonstrated by applying them to simulated data that possess known noise characteristics. It is shown that the accuracies predicted for the ideal observer can be achieved by the prewhitening technique.

25056 **(NBSIR—84-2838) Measurement techniques for high-power semiconductor materials and devices. Annual report, January 1, 1982 to March 31, 1983.** Thurber, W.R.; Lowney, J.R.; Phillips, W.E. (National Bureau of Standards, Washington, DC (USA). Center for Electronics and Electrical Engineering). Apr 1984. Contract AI01-76PR06010. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010425.

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This annual report is the final one in a series which describes NBS research to develop procedures for the effective utilization of deep-level measurements to detect and characterize defects which reduce lifetime or contribute to leakage current in power-device-grade silicon. During this reporting period, the previously written computer program for predicting excess-carrier lifetime was revised to calculate more accurately lifetimes for high or low injection conditions and in space-charge regions. Comparisons were made between lifetime measurements on platinum-doped silicon diodes and the predictions of the computer model. As part of the effort to extend the procedures to analyze data from nonexponential transient capacitance measurements, the time dependence of the capacitance-voltage relationship of a heavily platinum-doped silicon diode was measured as a function of bias voltage. Included as appendices are three recent publications resulting from the work. A listing of the lifetime-predicting computer program is also an appendix.

25057 **(SAND—83-2057) Thermal conductivity probe measurement system.** Drotning, W.D.; Tormey, T.V. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 83p. NTIS, PC A05; 3; GPO Dep. Order Number DE84008698.

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A thermal conductivity measurement system is described which uses the transient line source (probe) method. The measurement technique is applicable for conductivity determinations of powdered, porous, or other low conductivity materials, including solid and liquid specimens. The device employs hardware and software which allow its use as a portable stand-alone system, complete with data acquisition, data storage, and graphical data analysis functions. Documentation is provided which serves as a user's manual for the system operator. Several examples are provided which illustrate the use of the system and assist the operator in the selection of the correct data region for subsequent analysis. Measurements on a well characterized ceramic powder consisting of alumina microspheres are presented over the temperature range from 25 to 650 C. These results compare favorably with conductivity measurements on the same material using a different technique at other laboratories.

25058 **(SAND—83-2233C) Comparison of lightning flash rates from the PBE sensor and streak counting from the DMSP satellite.** Turman, B.N. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 3p. (CONF-840668—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006722.

From 7. conference on atmospheric electricity; Albany, NY, USA (4 Jun 1984).

A comparison of lightning trigger rates from the PBE sensor and streaks recorded by the accompanying optical scanner provides a calibration between these two lightning detection techniques. From this calibration is inferred the areal sensitivity of the optical scanner for lightning detection (2.6×10^4 km^2). Lightning flash density can be calculated from equations 9 and 10, and global flash densities have been calculated for dawn, dusk, and midnight for September to November 1977. From these results, the global flash rate is estimated to be about 50 s^{-1}. Lightning observations from a low-altitude satellite are very limited at best. These measurements give a rough estimate of lightning flash density, averaged over large areas and long times. Ultimately, however, a more sophisticated lightning detector on a geosynchronous satellite platform will be required for full-time monitoring of lightning activity to generate more accurate flash density data.

4404 Well Logging Instrumentation

25059 **(GJBX—2(84)) Parameter assignments for spectral gamma-ray borehole calibration models. National Uranium Resource Evaluation.** Heistand, B.E.; Novak, E.F. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Apr 1984. Contract AC07-76GJ01664. 49p. NTIS, PC E03/MF A01; GPO Dep. Order Number DE84010645.

Includes 5 sheets of 24x reduction microfiche.

This report documents the work performed to determine the newly assigned concentrations for the spectral gamma-ray borehole calibration models. Thirty-two models, maintained by the US Department of Energy, are included in this study, and are grouped into eight sets of four models each. The eight sets are located at sites across the United States, and are used to calibrate logging instruments. The assignments are based on in-situ logging data to ensure self-consistency in the assigned concentrations, and on laboratory assays of concrete samples from each model to provide traceability to the New Brunswick Laboratory (NBL) standards. 13 references, 7 figures, 17 tables.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

25060 **Detonation properties of 1,3,5-triamino-2,4,6-trinitrobenzene when impacted by hypervelocity projectiles.** Delistraty, J. (Lawrence Livermore National Lab., CA); Brandt, H. *Propellants, Explosives, Pyrotechnics;* 7: 113-122(1982). Contract W-7405-ENG-48.

The insensitive high explosive is composed of 92.5% of 1,3,5-trinitobenzene and 7.5% Kel-F 800 binder, a vinylidene fluoride-chlorotrifluoroethylene copolymer for simpoicity, TATB). Three of the projectiles are steel-rod assemblies ranging in weight from 32.6 g to 34.6 g. The steel rods are 8 mm in dia and 19 mm in length, of which 9 mm protrudes from a Polyzelux plastic holder. The fourth projectile is a tantalum-plate assembly, weight of 23.9 g. The tantalum plate is 24 mm in dia and is mounted on a Polyzelux holder. The purpose of this second type of projectile is to guarantee the detonation of the TATB target, thus providing a known reference point for a high-order, diverging detonation. The results of the steel-rod experiments are compared to the results of tantalum-plate experiments to determine if detonation has occurred upon the impact of the steel rods. The projectiles are accelerated by a 2-stage, light-gas gun to velocities which will bracket the detonation threshold of the impacted TATB target. Comparisons of the TATB reaction data to a computerized simulation of the experiment show that at 3.06 km/s, the computer correctly predicts no initiation of detonation; at 4.75 km/s, the computer correctly predicts a partial detonation; and at 5.67 km/s and 6.53 km/s, both the computer analyses and the experiments produce divergent detonations. 17 figures, 2 tables.

4503 Explosion Detection

25061 **(UCID—20057) Study of East Kazakh explosions and propagation in Central Asia using regional Chinese seismograms.** Patton, H.J.; Mills, J.M. Jr. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010623.

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Seismograms recorded at the Urumchi Station in northwestern China from eleven Asian events including seven presumed East Kazakh nuclear explosions were analyzed. Group velocity dispersion curves of Rayleigh waves were measured at short periods on paths through basin and fold belt terrains. At 10 sec period, the velocities on paths over sedimentary basins are 25% slower than velocities on paths over fold belts. We interpret those differences in velocities to be due to the great thicknesses of sedimentary deposits in basin terrains. Epicentral locations were estimated using differential travel times between P/sub n/ and L/sub g/ and particle motions of Rayleigh waves measured on a single three-component record. For a 1000 km path, the location errors (one standad deviation) are about +-125 km in azimuth and +-30 km in distance. In addition, systematic errors due to structural effects on surface-wave paths and on velocities of regional phases are shown to seriously bias location estimates of several events. We applied a differential phase method to Rayleigh waves from the East Kazakh explosions and found that signals of all events are in-phase with signals from the reference event on 10/12/80. Thus, there is no evidence for phase reversals or shifts at the Urumchi station in the frequency band where signal to noise ratio is good and where assumptions of the method are valid. Seismic moments of explosions were estimated using models of explosion sources with associated tectonic release. Observed amplitude spectra of Rayleigh waves were richer in high frequencies than predicted by the model. This could be a source effect related to source medium excitation (i.e., Green's functions) or a path effect caused by energy focussing and/or amplifications. We discuss the potential bias in the estimates of moment due to assumptions/limitations. 24 references, 16 figures, 6 tables.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 25076

25062 **(DOE/EV/10455—T1) Climatological analysis of the Hubbard Brook (New Hampshire) precipitation chemistry data. Final report.** Munn, R.E.; Likens, G.E.; Weisman, B.; Hornbeck, J.; Martin, C.W.; Bormann, F.H.; Oehlert, G.W.; Bloxam, R. (Toronto Univ., Ontario (Canada). Inst. for Environmental Studies). 30 Nov 1982. Contract FG01-80EV10455. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84008958.

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Precipitation chemistry data from Hubbard Brook, NH are of two types: event measurements, June 1975 to July 1978, inclusive; and weekly measurements from 1963 to May 1980, inclusive. In both cases, concentrations are available for a range of chemical constituents of the precipitation samples. Five-day back trajectories have been computed for the storms. Together with a crossing-trajectory analysis, the results show the influence of source regions on the chemical climatology of Hubbard Brook. With respect to the weekly measurements, the statistical properties of the data set have been investigated, and 850-mb precipitation chemistry wind roses for Portland, Maine have been constructed. The latter show that Na concentrations are high with ENE-SE winds and that the Ca/Na ratio is a good indicator of off-ocean vs off-land flows. Other results of the wind-rose analysis include: H^+ deposition and SO_4 deposition are high with S to WSW winds; NO_3 and H_4 concentrations are high with W-NW-N winds; and SO_4 concentrations are high with N-NE-E winds. Time series analyses of the 16-year data set have been undertaken. The results suggest: downward trends in concentrations of Na, Cl, Ca, Mg, K and Al and the ratio SO_4/NO_3, and upward trends in NO_3 deposition and the ratio NO_3/Na; in the case of pH, SO_4, NO_3 and NH_4, the time series seem to have changed slope about 1971; for the subset of cases with 850-mb winds from 300 to 069 deg., there is no trend in pH but a significant decline in SO_4 and NO_3 in winter; based on regional emission inventories for SO_2 and NO/sub x/ for the years 1965, 1970, 1975 and 1978, higher normalized wet depositions of SO_4 and NO_3 are associated with years having higher regional emissions of SO_2 and NO/sub x/, respectively. 15 references, 108 figures, 17 tables.

25063 **(LA-UR—84-1035) Statistical exploration of the effects of copper smelter emissions on visibility in southwestern National parks.** Williams, M.D.; Nochumson, D.H. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 17p. (CONF-840612—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009982.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

The copper strike in the summer of 1980 provided an opportunity to assess impacts of copper smelter emissions of the Southwest. Differences in sulfur composition between the summers of 1979 and of 1980 were significant at all of the Arizona NASN stations examined. The 1980 period showed decreased sulfate throughout most of the state with the largest changes near smelters. Outside of Arizona the aerosol sampling during 1979 was much less comprehensive with data for only three stations of interest available. Neither Zion nor Canyonlands showed significant differences and Mesa Verde showed an increase of sulfate rather than a decrease during the strike period. Visibility data in the parklands showed significant improvements in regions immediately east and northeast of the smelters - areas such as Bandelier National Monument, White Sands National Monument, Mesa Verde National Park, Chaco Culture National Historical Park, and Navajo National Monument. Park areas north to northwest of the smelters either showed no significant differences in visibility or reported decreased visibilities. Big Bend far to the southeast also reported decreased visibility during the strike. Examination of aerosol composition data near smelter sites suggested that high levels of copper, lead, and arsenic might be associated with high levels of sulfate. It appears that

the smelter emissions (1) increase sulfates over much of Arizona, (2) affect long term visibility in northeastern Arizona and New Mexico, and (3) produce short term elevated sulfate and reduced visibilities in the southwestern park areas during periods when the winds are appropriate to carry the emissions towards the park areas. 6 references, 1 figure, 11 tables.

25064 **(UCRL—89723) Definition of the concentration gradient above flammable liquids.** Munoz-Candelario, R.; Alvares, N.J. (Lawrence Livermore National Lab., CA (USA); Puerto Rico Univ., Mayaguez). 6 Feb 1984. Contract W-7405-ENG-48. 17p. (CONF-840689—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008296.

From ASTM/SFPE symposium on application of fire science to fire engineering; Denver, CO, USA (26 Jun 1984).

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We surveyed construction and operation-in-area codes concerned with the spill potential of flammable liquids that generate heavy vapor and the separation between these liquids and ignition sources. Our survey showed that acceptable separation distances between potential spill surfaces and ignition sources have increased over the years, intuitively on the name of safety. In order to understand the reasoning behind this, we inaugurated literature and experimental research. Our literature research revealed theoretical relationships that include a case for evaporating fluids with boundary conditions of diffusion of the volatile vapor through a stagnant gas film. In enclosed containers with open tops, the calculated vapor concentration gradients are monotonic and directly proportional to the fluid vapor pressure. To assess the validity of these calculated values, we performed experiments to determine the elevations at which flammable mixtures formed above the surfaces of low-volatility, high-vapor-density liquids. The tests involved vaporizing heptane and octane into long, open-ended tubes and then determining the heights at which the lower flammability limits were reached. Our results showed that the process does conform to the theoretical relationships we found in our literature search. 11 references, 4 figures.

25065 **Determination of organic and elemental carbon in atmospheric aerosol samples by thermal evolution.** Tanner, R.L.; Gaffney, J.S.; Phillips, M.F. (Brookhaven National Lab., Upton, NY). *Analytical Chemistry;* **55**: No. 9, 1627-2630(Aug 1983). Contract AC02-76CH00016.

A simple apparatus is described for determination of volatile organic and elemental carbon fractions in filter-collected atmospheric aerosol samples. The two-step technique involves rapid heating and thermoevolution of organic carbon at 400°C in helium carrier gas, followed by removal of elemental carbon at 700°C in 10% O_2/He. Evolved carbon is converted to CO_2 on copper oxide catalyst, purified, and analyzed by nondispersive infrared (NDIR) spectrometry. Flash heating of ambient aerosol samples minimizes organic-to-elemental carbon conversion, allowing determination of organic and elemental carbon fractions with relative standard deviations of +/-8% and +/-12%, respectively, for total carbon loadings of 6-50 μg of C/cm^2 filter area. Blank filter variability, sample heating duration, and the effects of sample heating rates and pyrolysis temperature are evaluated. Ambient aerosol carbon data from both urban and remote sampling sites are presented and discussed.

25066 **Electrical aerosol analyzer: an alternate method for use at high altitude or reduced pressure.** Yeh, H.C.; Cheng, Y.S. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Atmospheric Environment;* **16**: No. 5, 1269-1270(1982). Contract AC04-76EV01013.

So that the Electrical Aerosol Analyzer (EAA) might be used to determine submicron aerosol size distributions at reduced pressure, Yeh et al. (1981) developed a method by modifying the standard data reduction table. Based on the same assumptions i.e., the particle charging is independent of pressure when the charging parameter Nt [N (ion concentration), t (charging time)], Nt, is held constant, an alternative method was developed. A test indicated that these two methods are comparable and the agreement between the two is very good. The advantage of the present method is that all existing EAA data analysis packages or computer programs can be directly applied without any modification. 1 figure, 1 table.

25067 **Atmospheric processes leading to the occurrence of acid precipitation.** Hales, J.M. (Pacific Northwest Lab., Richland, WA). pp 29-47 of California symposium on acid precipitation. San Francisco, CA; California Air Resources Board (1981). (CONF-810131—).

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

The major ionic contributors to precipitation chemistry are discussed and classified according to anions and cations. It is emphasized that there is much variability in the chemical content of rainfall during the progress of a storm. The occurence of acid precipitation is the consequence of a general material balance of pollution in the atmosphere. The steps in the formation of acid precipitation are itemized and illustrated. First, the pollutant must make contact with the storm system and occupy the same air space. A cyclonic mid-latitude storm is discussed using Bjreknes' cyclone model to explain the acid delivery into the rain system in the contacting process. Secondly, the pollutant must attach to the condensed water. Several processes are presented for attachment. They are: cloud-droplet nucleation; droplet growth; and accretion of cloud droplets by falling hydrometeors. Finally, relatively little is known about what the pollutant does afterwards and how it is tranported to the ground. The rain formation process is often an important rate-limiting step. A field study for the US and Canada that will occur in 1981 is described. The objective of this study is to create a data base with regard to the dynamic and chemical features of cyclonic storm systems as the cross the US.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 24746, 25103

25068 **(NUREG—0837-Vol.3-No.3) NRC TLD Direct Radiation Monitoring Network. Progress report, July-September 1983. Vol. 3, No. 3.** Costello, F.; Thompson, T.; Cohen, L.; Taylor, M. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Mar 1984. 139p. NTIS, PC A07/MF A01 - GPO*. Order Number DE84900989.

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The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network is operated by the NRC in cooperation with participating states to provide continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an unusual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the third quarter of 1983. A complete listing of the site facilities monitored is included. All radiation measurements are made using thermoluminescent dosimeters (TLDs). Each site is monitored by arranging approximately 40 to 50 TLD stations in two concentric rings extending to about five miles from the facility. The radiation levels are presented as gross and net exposures.

25069 **(SAND—84-1920C) Radiotracer method for the study of the effectiveness of various materials for mitigating the dispersal of radioactive substances.** Bild, R.W.; Kenna, B.T. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 10p. (CONF-840408—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010266.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

A radioactive tracer method for studying the effectiveness of various materials to mitigate the explosively driven dispersal of radioactive substances into air has been developed and applied. Experiments are conducted in a facility call CON-CON (for Conical Containment) 1 which simulates the effects of a 23 lb (10.5 kg) spherical high explosive charge. Up to 3.7 x 10^7 Bq (10 mCi) of ^{24}Na tracer in the form of <325 mesh sodium titanate powder is used in each test. Airborne tracer which breaches the mitigator is collected using cascade impactor air samplers and analyzed by

gamma ray counting. Detection sensitivity for the tracer is about 1 part in 10^9 to 10^{10} of the original tracer. Experiments have been conducted with air, dry sand and aqueous foam mitigators. The dry sand decreases the amount of tracer collected by about a factor of 10 to 100 and foam by factors of 2000 to 4000 relative to baseline (no mitigator) tests.

25070 **Relationship between plutonium activity densities of airborne and surface soils.** Sehmel, G.A. (Pacific Northwest Lab., Richland, WA). *Health Physics;* **45**: No. 6, 1047-1050(Dec 1983). Contract AC06-76RL01830.

The purpose here is to summarize data for plutonium as a pollutant on airborne and surface soils, if both are available at study sites, and to examine the data for relationships between plutonium concentrations on airborne soils and on surface soils near the airborne particulate sampling sites. In practice, surface soil samples are actually soil samples taken to a sampling depth. Only data for sites will be summarized for which the plutonium concentrations on both airborne and surface soils have been investigated. These sites include the Bikini Atoll, the Hanford Site, and Rocky Flats.

5006 Regulations

25071 **(EPA—450/3-83-018a) Review of new source performance standards for primary copper smelters. Chapters 1 through 9.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1984. 582p. NTIS, PC A25/MF A01. Order Number DE84900964.

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Standards of performance for the control of emissions from primary copper smelters were promulgated in 1976. Developments since promulgation necessitated that the following be included in the periodic review of the standards: (1) reexamination of the current exemption for reverberatory furnaces processing high-impurity materials, (2) assessment of the feasibility of controlling particulate matter emissions from reverberatory furnaces processing high-impurity materials, (3) reevaluation of the impact of the current standard on the ability of existing smelters to expand production, and (4) assessment of the technical and economic feasibility of controlling fugitive emissions at primary copper smelters. The results of the review indicated that no changes should be made to the existing standard. This document contains background information and environmental and economic assessments considered in arriving at this conclusion. 99 references, 75 figures, 110 tables.

25072 **(EPA—450/3-83-018b) Review of new source performance standards for primary copper smelters. Appendices.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1984. 161p. NTIS, PC A08/MF A01. Order Number DE84900965.

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Standards of performance for the control of emissions from primary copper smelters were promulgated in 1976. Developments since promulgation necessitated that the following be included in the periodic review of the standards: (1) reexamination of the current exemption for reverberatory furnaces processing high-impurity materials, (2) assessment of the feasibility of controlling particulate matter emissions from reverberatory furnaces processing high-impurity materials, (3) reevaluation of the impact of the current standard on the ability of existing smelters to expand production, and (4) assessment of the technical and economic feasibility of controlling fugitive emissions at primary copper smelters. The results of the review indicated that no changes should be made to the existing standard. This document contains background information and environmental and economic assessments considered in arriving at this conclusion. This, volume 2, contains the appendices. 4 figures, 38 tables.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

25073 **Uv-sensitive complex phosphorus: association with dissolved humic material and iron in a bog lake.** Francko, D.A. (Michigan State Univ., Hickory Corners); Heath, R.T. *Limnology and Oceanography;* **27**: No. 3, 564-569(1982). Contract AC02-76EV01599.

The concentration of uv-sensitive complex phosphorus compounds in water from an acid bog lake was linearly related to the concentration of dissolved high molecular weight humic material (DHM) both seasonally and diurnally. The first-order rate of photoreduction (Fe^{3+} to Fe^{2+}) of DHM..iron equaled the rate of release of orthophosphate (SRP) from these compounds. The rate of photoreduction of DHM..iron was the same as the rate of photoreduction of ferric citrate under similar conditions. Reduced DHM..iron was auto-oxidizable (Fe^{2+} to Fe^{3+}); ferrous citrate was not. These data support the view that orthophosphate sorbed to ferric iron..DHM complexes may be released by a mechanism involving uv-induced photoreduction of ferric iron to the ferrous state.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 24581, 24628, 25070, 25074

5105 Site Resource And Use Studies

25074 **(DP—1642) Savannah River Plant environment.** Dukes, E.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1984. Contract AC09-76SR00001. 254p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84010620.

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On June 20, 1972, the Atomic Energy Commission designated 192,323 acres of land near Aiken, SC, as the nation's first National Environmental Research Park. The designated land surrounds the Department of Energy's Savannah River Plant production complex. The site, which borders the Savannah River for 17 miles, includes swampland, pine forests, abandoned town sites, a large man-made lake for cooling water impoundment, fields, streams, and watersheds. This report is a description of the geological, hydrological, meteorological, and biological characteristics of the Savannah River Plant site and is intended as a source of information for those interested in environmental research at the site. 165 references, 68 figures, 52 tables.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 25073

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 24606, 24607

25075 **Potential impact of acid precipitation on aquatic ecosystems of the western slope of the Sierra Nevada.** Tonnessen, K. (Univ. of California, Berkeley). pp 209-220 of California symposium on acid precipitation. San Francisco, CA; California Air Resources Board (1981). (CONF-810131—).

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

The potential for damage by acid precipitation to the freshwater lake ecosystems of the Sierra was investigated by means of a two phased research program. The first phase was a field study of 25 small, high-altitude Sierra lakes. The parameters measured were: pH, alkalinity, phytoplankton species composition, Ca and Mg concentrations, and trace metal concentrations. The emphasis was on establishing baseline levels of dissolved metals in the water column. The metals were Al, Cd, Cu, Mn, Fe, Pb, and Zn. The second phase of the work was a laboratory research program designed to investigate the ecological effects of acid precipitation on these lakes. Again the emphasis was on pH and metal interactions, which involved artificial acidification of simulated lake systems under controlled conditions. Results indicate that the lakes in the Sierra have a low buffering capacity. Presently, the pH of the lakes is between six and seven. Nothing extraordinary was observed in the chemistry or biology of the lakes. Based on the laboratory research, acidified systems differ in recovery time and percent of recovery, and when stressed by acid inputs these lakes respond with changes in metals levels and biological populations.

25076 **Acid precipitation on the western slope of the high Colorado Rockies.** Harte, J. (Lawrence Berkeley Lab., CA). pp 245-253 of California symposium on acid precipitation. San Francisco, CA; California Air Resources Board (1981). (CONF-810131—).

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

Field studies were performed to measure the pH and alkalinity in the precipitation and surface waters in the high Colorado Rockies. The mean pH was found to be 4.2 in the summer rain and 4.17-4.9 in early snow. An investigation of Galena Lake revealed a pH of 6. One of the unanswered questions concerns the length of time it will take before the pH of the lake begins to be depressed. With that low alkalinity and continuing precipitation with pH of 4.2, it is inevitable that eventually the lake will see a drop in pH. A series of new studies will be needed to determine this length of time.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 24991

25077 **(PNL—4546) Multimedia contaminant environmental exposure assessment methodology as applied to Los Alamos, New Mexico.** Whelan, G.; Thompson, F.L.; Yabusaki, S.B. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1983. Contract AC06-76RL01830. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010762.

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The MCEA (Multimedia Contaminant Environmental Exposure Assessment) methodology assesses exposures to air, water, soil, and plants from contaminants released into the environment by simulating dominant mechanisms of contaminant migration and fate. The methodology encompasses five different pathways (i.e., atmospheric, terrestrial, overland, subsurface, and surface water) and combines them into a highly flexible tool. The flexibility of the MCEA methodology is demonstrated by encompassing two of the pathways (i.e., overland and surface water) into an effective tool for simulating the migration and fate of radionuclides released into the Los Alamos, New Mexico region. The study revealed that: (a) the ^{239}Pu inventory in lower Los Alamos Canyon increased by approximately 1.1 times for the 50-y flood event; (b) the average contaminant ^{239}Pu concentrations (i.e., weighted according to the depth of the respective bed layer) in lower Los Alamos Canyon for the 50-y flood event decreased by 5.4%; (c) ~ 27% of the total ^{239}Pu contamination resuspended from the entire bed (based on the assumed cross sections) for the 50-y flood event originated from lower Pueblo Canyon; (d) an increase in the ^{239}Pu contamination of the bed followed the general deposition patterns experienced by the sediment in Pueblo-lower Los Alamos Canyon; likewise, a decrease in the ^{239}Pu contamination of the bed followed general sediment resuspension patterns in the canyon; (e) 55% of the ^{239}Pu reaching the San Ildefonso Pueblo in lower Los Alamos Canyon originated from lower Los Alamos Canyon; and (f) 56% of the ^{239}Pu contamination reaching the San Ildefonso Pueblo in lower Los Alamos Canyon was carried through towards the Rio Grande. 47 references, 41 figures, 29 tables.

25078 **(UCID—19997) Plutonium and americium behavior in coral atoll environments.** Noshkin, V.E.; Wong, K.M.; Jokela, T.A.; Brunk, J.L.; Eagle, R.J. (Lawrence Livermore National Lab., CA (USA)). 1 Feb 1984. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010920.

Inventories of $^{239+240}$Pu and ^{241}Am greatly in excess of global fallout levels persist in the benthic environments of Bikini and Enewetak Atolls. Quantities of $^{239+240}$Pu and lesser amounts of ^{241}Am are continuously mobilizing from these sedimentary reservoirs. The amount of $^{239+240}$Pu mobilized to solution at any time represents 0.08 to 0.09% of the sediment inventories to a depth of 16 cm. The mobilized $^{239+240}$Pu has solute-like characteristics and different valence states coexist in solution - the largest fraction of the soluble plutonium is in an oxidized form (+V,VI). The adsorption of plutonium to sediments is not completely reversible because of changes that occur in the relative amounts of the mixed oxidation states in solution with time. Further, any characteristics of $^{239+240}$Pu described at one location may not necessarily be relevant in describing its behavior elsewhere following mobilization and migration. The relative amounts of ^{241}Am to $^{239+240}$Pu in the sedimentary deposits at Enewetak and Bikini may be altered in future years because of mobilization and radiological decay. Mobilization of $^{239+240}$Pu is not a process unique to these atolls, and quantities in solution derived from sedimentary deposits can be found at other global sites. These studies in the equatorial Pacific have significance in assessing the long-term behavior of the transuranics in any marine environment. 22 references, 1 figure, 13 tables.

25079 **(UCRL—89843) Radionuclides in plankton from the South Pacific Basin.** Marsh, K.V.; Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA)). 23 Mar 1984. Contract W-7405-ENG-48. 11p. (CONF-840408—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008943.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

We have initiated an investigation of the utility of marine plankton as bioconcentrating samplers of low-level marine radioactivity in the southern hemisphere. A literature review has shown that both freshwater and marine plankton have trace element and radionuclide concentration factors (relative to water) of up to 10^4. We participated in Operations Deepfreeze 1981 and 1982, collecting a total of 48 plankton samples from the USCGC Glacier on its Antarctic cruises. Battelle Pacific Northwest Laboratories sampled air, water, rain, and fallout. We were able to measure concentrations in plankton of the naturally-occurring radionuclides ^{7}Be, ^{40}K, and the U and Th series, and we believe that we have detected low levels of ^{144}Ce and ^{95}Nb in seven samples ranging as far south as 68°. Biological identification of the plankton suggests a possible correlation between radionuclide concentration and the protozoa content of the samples. 7 references, 5 figures.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 25074

25080 **(FWS/OBS—82/69) Ecological characterization of the Mississippi Deltaic Plain region: a narrative with management recommendations.** Bahr, L.M. Jr.; Costanza, R.; Day, J.W. Jr.; Bayley, S.E.; Neill, C.; Leibowitz, S.G.; Fruci, J. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Sep 1983. 201p. National Coastal Ecosystems Team, US Fish and Wildlife Service, 1010 Gause Boulevard, Slidell, LA 70458.

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This report is a descriptive narrative aimed at characterizing the region's ecology and its environmental problems. A companion technical report (Costanza et al. 1983) was also prepared that includes more detailed quantitative descriptions of the major ecological habitats of the region. The data collected in the technical report

are intended to serve as a data base for addressing specific environmental management questions. This narrative report summarizes: (1) the major classes of environmental problems, their complex origins and interdependencies, (2) the natural systems of the region, their histories, structure, and function, (3) the recommendations that have been proposed to deal with the environmental problems of the region, and (4) how the data base assembled in the technical report might help in dealing with these problems more rationally. 285 references, 62 figures, 27 tables.

25081 **(TVA—4900928) Results of fish community monitoring in Barkley Reservoir, 1983.** Swor, C.T.; Wrenn, W.B.; Lowery, D.R. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Mar 1984. 89p. NTIS, PC A05/MF A01. Order Number DE84900928.

This report describes fish stocks inhabiting shoreline and cove areas of Barkley Reservoir as measured by rotenone surveys conducted by TVA in July 1983. Included are data on species composition, numbers per hectare, biomass (kg/ha), and size distributions of fish in Barkley Reservoir in 1983. Emphasis is placed on comparison of standing stocks upstream and downstream of CUF (Cumberland Steam-Electric Plant), comparison of 0.4 ha vs 0.8 ha survey results, and determination of long-term trends in standing stocks of important species. 12 references, 33 figures, 15 tables.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

25082 **(DOE/ER/13107—1) Role of Ca^{2+} and calmodulin in phosphorylation of proteins in plants. Progress report.** Cormier, M.J. (Georgia Univ., Athens (USA). Dept. of Biochemistry). 4 Apr 1984. Contract AS09-83ER13107. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008593.

The objective of the research is to provide an understanding of in vitro requirements for Ca^{+2} dependent protein phosphorylation in plant cells and determine whether this Ca^{+2} mediated phosphorylation represents one of the underlying mechanisms by which plants respond to external stimuli. A higher plant model system (soybean cells) has been identified. Both membrane and supernatant fractions were found to contain Ca^{+2} dependent protein kinases. Further work will concentrate on the supernatant protein fraction in order to isolate, to homogeneity, the proteins of interest. Casein and lysine-rich histones were found to be good substrates for use in an assay for one of the Ca^{+2} dependent kinases. Current work involves isolating and characterizing the Ca^{+2} dependent protein kinases, and some of their substrates from the soluble fraction of extracts of soybean cell cultures.

5502 Biochemistry

REFER ALSO TO CITATION(S) 24927, 24967, 25093, 25094

25083 **Decreased immunoglobulin production by a human lymphoid cell line following melphalan treatment.** Griffin, G.D. (Oak Ridge National Lab., TN); Owen, B.A.; Atchley, C.E.; Novelli, G.D.; Solomon, A. *Cancer Research;* **42**: 4505-4510(Nov 1982). Contract W-7405-ENG-26.

The effect of melphalan on immunoglobulin G (IgG) production by a human lymphoblastoid cell line (BF) was studied. The amount of secreted IgG and the percentage of cells containing cytoplasmic IgG were measured by immunoassay and cytofluorometry, respectively. Dose-response studies indicated that melphalan concentrations of 2×10^{-8} M had no effect, while concentrations of 8×10^{-7} M were totally toxic, after 72-h exposures to the drug. Statistically significant, persistent, alterations in both synthesis and secretion of IgG by BF cells were observed following treatment for 72 h with 4×10^{-7} M melphalan, and there was an increase in population-doubling time from 24 to 72 h in these drug-treated cells. The percentage of IgG-containing cells in melphalan-treated cultures was significantly decreased as compared to control cultures. IgG secretion was also decreased in these cultures, and the variation in IgG secretion as a function of cellular growth was significantly altered following melphalan treatment. Decreased IgG production following melphalan treatment may be related to altered cell cycle kinetics. Based on immunological analysis, there was no evident alteration in the IgG secreted by melphalan-treated cells, nor did melphalan treatment produce a cellular population lacking IgG entirely.

25084 **Synchrotron radiation sources for photobiology and ultraviolet, visible and infrared spectroscopy.** Sutherland, J.C. (Biology Dept., Brookhaven National Lab., Upton, NY 11973). pp 11-19 of Trends in photobiology. Helene, C.; Charlier, M.; Montenay-Garestier, Th. New York, NY; Plenum Publishing Corp. (1982). (CONF-800762—).

From 8. international congress on photo-biology; Strasbourg, France (20 Jul 1980).

This chapter points out the advantages of synchrotron radiation in several types of spectroscopy, microscopy and diffraction studies. Examines synchrotron radiation as a probe of biological structure and dynamics, and synchrotron light sources. Mentions the different ways in which x-rays from a synchrotron may be used to probe the structure of biological materials. Divides biological applications of synchrotron radiation in the ultraviolet, visible and infrared (UVISIR) regions of the spectrum into two classes based on the use which is made of the time structure of the radiation. Predicts that the availability of synchrotron radiation will expand rapidly in the early 1980's as experimental programs start at the new generation of dedicated storage rings.

25085 **Primary processes in the photochemistry of proteins.** Grossweiner, L.I.; Blum, A.; Brendzel, A.M. (Biophysics Lab., Physics Dept. Inst. of Technology, Chicago, IL 60616). pp 67-80 of Trends in photobiology. Helene, C.; Charlier, M.; Montenay-Garestier, Th. New York, NY; Plenum Publishing Corp. (1982). (CONF-800762—). Contract AC02-76EV02217.

From 8. international congress on photo-biology; Strasbourg, France (20 Jul 1980).

This chapter reviews the pre-1970 theories of enzyme inactivation by ultraviolet (UV) and proposes a modified form based on quantum yield measurements. Relates the inactivation model to flash photolysis studies on enzymes carried out from 1971 to 1978. Describes current laser flash photolysis research on aromatic amino acids and enzymes that provides new evidence for multiple pathways of aromatic residue photolysis, depending on the exciting wavelengths and microenvironment of the residue. Points out that the photoionization of aromatic residues is the major initial process identified by UV flash photolysis of proteins. Explains the correlation between photoionized tryptophy and tyrosyl residues and exposure to the aqueous medium by new results indicating that the electron are released from CTTS states formed only in high dielectric constant environments. Finds that structural considerations indicate that destruction of crystal bridges alters the active conformation, whereas tryptophyl residue destruction is inactivating if the residue is part of the active center or is located adjacent to a key catalytic residue.

25086 **Naturally occurring pyrimidodiazepine in Drosophila: chemical and spectral properties and relationship to drosopterin.** Jacobson, K.B. (Oak Ridge National Lab., TN); Dorsett, D.; Pfleiderer, W.; McCloskey, J.A.; Sethi, S.K.; Buchanan, V.; Rubin, I.B. *Biochemistry;* **21**: No. 22, 5700-5706(1982). Contract W-7405-ENG-26.

The structure of an intermediate, in drosopterin biosynthesis, as 6-acetylpyrimidodiazepine has been confirmed by high-resolution mass spectra. ^{13}C NMR, chemical ionization mass spectra, and chemical properties. A trivial name of 6-acetylhomopterin is suggested and should replace the term quench spot used heretofore. The structure of drosopterin includes, in part, a pyrimidodiazepine, a compound that consists of a fused six- and seven-membered heterocyclic ring system. Earlier studies demonstrated that 6-acetylhomopterin strongly stimulated the enzymatic synthesis of drosopterin and related eye pigments by preparations from Drosophila. The occurrence in nature is quite limited for diazepines; drosopterin and homopterin are the first examples in eukaryotes.

25087 **Calibration of denaturing agarose gels for molecular weight estimation of DNA: size determination of the single-stranded genomes of parvoviruses.** Snyder, C.E. (Oak Ridge National Lab., TN); Schmoyer, R.L.; Bates, R.C.; Mitra, S. *Electrophoresis (Weinheim, Federal Republic of Germany);* **3**: 210-213(1982). Contract W-7405-ENG-26.

Vertical slab gel electrophoresis of DNA with CH_3HgOH-containing agarose produces sharp bands whose mobilities are suitable for size estimation of single-stranded DNA containing 600 to 20,000 bases. The relationship of electrophoretic mobility to size of DNA over this range is a smooth, S-shaped function, and an empirical model was developed to express the relationship. The model involves terms in squared and reciprocal mobilities, and produced excellent fit of known standard markers to measured mobilities. It was used to estimate the sizes of six parvovirus DNAs: Kilham rat virus (KRV), H-1, LuIII, and minute virus of mice (MVM) DNAs had molecular weights of 1.66 to 1.70 x 10^6, while the molecular weight of bovine parvovirus (BPV) DNA was 1.84 x 10^6 and that of adenoassociated virus (AAV) DNA was 1.52 x 10^6.

25088 **Anion-exchange high-performance liquid chromatography of human serum apolipoproteins.** Ott, G.S.; Shore, V.G. (Lawrence Livermore National Lab., CA). *Journal of Chromatography;* **231**: 1-12(1982). Contract W-7405-ENG-48.

The rapid separation of seven urea-soluble apolipoprotein species from delipidated human serum very low density lipoproteins (VLDL) and high density lipoproteins (HDL) has been achieved by high-performance liquid chromatography on an anion-exchange column of Syn-Chropak AX 300. Effluent chromatographic peaks were detected by absorbance at 280 nm in a flow-through cell. Peaks corresponding to apolipoproteins AI_1, AI_2, AII, CI, CII, $CIII_1$, and $CIII_2$ were identified by amino acid analysis, gel electrophoresis, and isoelectric focusing. Maximum efficient loading of semipreparative columns (250 x 9.0 mm) was established to be ca. 20 mg HDL apolipoprotein. Minimum detectable protein was shown to be ca. 1 μg on an analytical-scale column (300 x 4.5 mm). Chromatographic resolution is comparable to that of conventional DEAE-cellulose column chromatography. The ratio of $apoAI_1$ to $apoAI_2$ was considerably greater in high-performance liquid chromatography, suggesting that the variants seen in conventional chromatography and isoelectric focusing are in part artifactual.

5503 Cytology

REFER ALSO TO CITATION(S) 25095, 25096, 25101

25089 **Simple methods to determine and compare the sensitivity of flow cytometers.** Pinkel, D. (Lawrence Livermore National Lab., CA); Steen, H.B. *Cytometry (Baltimore);* **3**: No. 3, 220-223(1982). Contract W-7405-ENG-48.

Knowledge of the sensitivity of a flow cytometer is important both in choosing an instrument for a particular application and in determining whether the resolution obtained on real samples is limited by instrumental factors or sample variability. The coefficient of variation (CV) obtained for a measurement is given by $CV^2 = CV/sub\ s/^2 + CV_1^2 + 1/n + K(\delta\ V/sub\ B/^2)/n^2$, where CV/sub s/ is the variability due to the sample, CV_1 that due to variations in illumination of the sample particles, n the number of photoelectrons emitted from the photomultiplier photo cathode per sample particle (which is the signal intensity), δV/sub B/² the mean square background noise voltage (usually due to background illumination), and K a constant. Measurement of the CV of light flashes from a light emitting diode as a function of their intensity allows development of standard curves which can be used to directly determine the degree to which the resolution obtained on actual samples is limited by signal intensity and background light. The use of stanxdard particles allows relative calibration of the curves for different instruments and which also ranks their sensitivities. 1 figure.

25090 **Analysis and interpretation of DNA distributions measured by flow cytometry.** Dean, P.N.; Gray, J.W.; Dolbeare, F.A. (Lawrence Livermore National Lab., CA). *Cytometry (Baltimore);* **3**: No. 3, 188-195(1982). Contract W-7405-ENG-48.

A principal use of flow cytometers is for the measurement of fluorescence distributions of cells stained with DNA specific dyes. A large amount of effort has been and is being expended currently in the analysis of these distributions for the fractions of cells in the G_1, S, and G_2 + M phases of the cell cycle. Several methods of analysis have been proposed and are being used; new methods continue to be introduced. Many, if not most, of these methods differ only in the mathematical function used to represent the phases of the cell cycle and represent attempts to fit exactly distributions with known phase fractions or unusual shapes. In this paper we show that these refinements probably are not necessary because of cell staining and sampling variability. This hypothesis was tested by measuring fluorescence distributions for Chinese hamster ovary and KHT mouse sarcoma cells stained with Hoechst-33258, chromomycin A3, propidium iodide, and acriflavine. Our results show that: a) single measurements can result in phase fraction estimates that are in error by as much as 40% for G_2 + M phase and 15 to 20% for G_1 and S phases; b) different dyes can yield phase fraction estimates that differ by as much as 40% due to differences in DNA specificity; c) the shapes of fluorescence distributions and their interpretation are very dependent on the dye being used and on its binding mechanism. 7 figures, 2 tables.

5504 Genetics

25091 **(DOE/ER/60014—1) Evolution of correlated characters in complex genetic systems and at the phenotypic level. Progress comprehensive report, September 1, 1981-August 31, 1984.** Lande, R.S. (Chicago Univ., IL (USA)). Apr 1984. Contract AC02-81ER60014. 56p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010509.

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Selection on chromosomal rearrangements can occur through breakpoint or position effects, or by linkage with a favorable combination of genes. Two models have been derived to analyze the evolutionary processes governing the spread and fixation of major chromosomal rearrangements. The first model deals with inversions, which effectively reduce or suppress recombination within and around the inverted region in structural heterozygotes. The selective value of genes linked to inversions is therefore of considerable importance in their evolution. The second model considers the fixation of chromosomal rearrangements as a simple example of Sewall Wright's shifting balance theory of evolution in a strongly subdivided population. These models, which are described fully in the papers attached.

5505 Metabolism

REFER ALSO TO CITATION(S) 24969, 25098

25092 **Citrate transport in corn mitochondria.** Birnberg, P.R.; Jayroe, D.L.; Hanson, J.B. (Univ. of Illinois, Urbana). *Plant Physiology;* **70**: 511-516(1982). Contract AC02-76EV00790.

Citrate uptake by corn mitochondria (Zea mays L. B73 x Mo19) was investigated by osmotic swelling and [^{14}C]citrate accumulation. Uptake driven by passive influx, ammonium gradients, and respiration was followed. There was no requirement for phosphate and/or malate to secure citrate uptake, although under some conditions these additives were promotive. Inhibition of the phosphate and dicarboxylate carriers did not eliminate citrate uptake. Citrate/sub in//malate/sub out/ exchange occurs, but at a rate too slow to account for observed citrate uptake, and depletion of endogenous malate only reduced citrate uptake by 38%. It was concluded that citrate can be rapidly accumulated by a mechanism other than by exchange for dicarboxylates. The effect of uncoupler on respiration-driven [^{14}C]citrate accumulation, and studies of passive swelling using ionophores and uncouplers indicated that the major avenue of citrate uptake is by H^+/citrate cotransport with a pH optimum near 4.5. The in vivo role of this mechanism is not yet understood.

5507 Microbiology

25093 2-Bromoethanesulfonate: a selective agent for isolating resistant Methanosarcina mutants. Smith, M.R.; Mah, R.A. (Univ. of California, Los Angeles). *Current Microbiology;* **6**: 321-326(1981). Contract AT03-80ER10684;AM03-76SF00034.

Sodium 2-bromoethanesulfonate (BES), a structural analog of 2-mercaptoethane sulfonate (coenzyme M), inhibited methanogenesis and growth of Methanosarcina strain 227 in the presence of H_2/CO_2, methanol, or acetate. A single exposure to 24 μM BES was sufficient to produce cultures resistant to 240 μM BES. Wild-type cultures inhibited by 200 μM BES (or less) resumed growth and methane production when coenzyme M (coM) was added to the culture medium. Cultures incubated one week or longer with 200 μM BES (or less) spontaneously resumed growth and methanogenesis in the presence of H_2/CO_2, methanol, or acetate without added coM. BES resistance was heritable and not the result of inactivation or decomposition of BES. BES resistance acquired on one methanogenic substrate was retained when cells were grown on a different methanogenic substrate. However, BES resistance did not confer multiple resistance to other halomethane compounds such as chloroform, 2-bromoethanol, 2-bromopropionic acid, and chloramphenicol. BES resistance varied in two other genera of methanogens tested. One strain of Methanospirillum hungatei was very sensitive to BES, and no resistant mutants were demonstrated. One strain of Methanobacterium formicicum, however, was resistant to 200 μM BES without any known prior exposure to BES.

25094 Some resent observations on the relationships between homothallic and heterothallic species of Neurospora. Dutta, S.K.; Frederick, L.; Austin, W.L. (Howard Univ., Washington, DC). *Journal of the Elisha Mitchell Scientific Society;* **97**: No. 2, 126-135(1981).

There has been a question about whether homothallic species of the genus Neurospora are congeneric with the heterothallic species. This paper reviews previous studies and reports on new evidence pertaining to this question. DNA studies, isozyme analyses, and observations on ascospore rib development all support intrageneric relatedness of the homothallic and heterothallic species.

5508 Morphology

25095 Surface morphology and functional studies of human alveolar macrophages from cigarette smokers and nonsmokers. Finch, G.L. (Univ. of California, Berkeley); Fisher, G.L.; Hayes, T.L.; Golde, D.W. *RES, Journal of the Reticuloendothelial Society;* **32**: 1-23(1982). Contract W-7405-ENG-48.

The surface of macrophages inhabiting the peritoneal and alveolar spaces is pleomorphic in structure. The internal structure of these cells has been widely described and is not discussed here. Although external cell morphology has been well characterized by many researchers, this subject has not been reviewed. This review, therefore, describes in detail the surface features of macrophages as well as factors affecting macrophage morphology. Morphological studies of human cells are emphasized. Functional studies are presented and, when possible, morphological parameters are correlated with cell function. Because cigarette smoking has been well studied, the effects of this pulmonary insult are described in detail.

5509 Pathology

REFER ALSO TO CITATION(S) 25083, 25105

25096 Role of limited cell replicative capacity in pathological age change. A review. Walton, J. (Lawrence Livermore National Lab., CA). *Mechanisms of Ageing and Development;* **19**: 217-244(1982). Contract W-7405-ENG-48.

Physiological functions are carried out by differentiated cells, with finite lifespans, which age and need to be replaced. In young individuals, tissue functions are sustained at optimal levels because cellular dysfunction and cell loss are balanced by the emergence of newly differentiated cells as stem cells and their partially differentiated descendants replicate. However, with the passage of time the mitotic rates of these cells diminish. Eventually, replications occur too infrequently to offset the loss. It is at this point that the tissue begins to show structural changes and declining function which, as they become pervasive, are identified as ageing. In this paper the theory is set forth that: (1) Diminishing mitotic activity in older tissues results from limited stem cell replicative capacity. (2) All stem cells, regardless of tissue, exhibit similar replicative patterns over time, progressing from the actively proliferating to the nonproliferating state. However, stem cells in different kinds of tissue have different rates of replicative decline, with the result that some tissues show age earlier than others. (3) The combination of two cellular properties - differentiated cell ageing and limited stem cell replicative capacity - is sufficient to establish the framework in which other pathological changes characteristic of aged people and animals take place.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 25083, 25100, 25102

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 25106

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 25084, 25085

25097 (PNL—5000-Pt.4) Pacific Northwest Laboratory, annual report for 1983 to the DOE Office of Energy Research. Part 4. Physical sciences. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 84p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84007905.

Part 4 of the Pacific Northwest Laboratory Annual Report for 1983 to the Office of Energy Research, includes those programs funded under the title Physical and Technological Research. The Field Task Program Studies reports in this document are grouped under the subheadings and each section is introduced by a divider page that indicates the Field Task Agreement reported in that section. These reports only briefly indicate progress made during 1983. The reader should contact the principal investigators named or examine the publications cited for more details.

25098 Clearance of ^{202}Tl contaminate following intravenous injection of ^{201}Tl. Berger, C.D.; Lane, B.H.; Hamrick, T. (Oak Ridge National Lab., TN). *Health Physics;* **45**: No. 5, 999-1001(Nov 1983). Contract W-7405-ENG-26.

The ORNL Whole Body Counter was used to estimate the clearance of ^{202}Tl in a 50-year-old male who was given 2 mCi of ^{201}Tl intravenously on 10 June 1981 for a cardiac perfusion study. He has no record of internal deposition of other radionuclides, and, after completion of the medical procedure, he took no medication other than a blood pressure suppressor and potassium chloride.

25099 Oncogenic transformation of mouse BALB/3T3 cells by plutonium-238 alpha particles. Robertson, J.B. (Harvard School of Public Health, Boston, MA); Koehler, A.; George, J.; Little, J.B. *Radiation Research;* **96**: No. 2, 261-274(Nov 1983).

The A31-11 mouse BALB/3T3 cell system was adapted for the study of malignant transformation induced by 5.3 MeV alpha particles from a specially constructed ^{238}Pu source. The biologic effects were compared to those of 220 kVp x rays. The alpha-radiation survival curve showed a D_0 of 70 rad and a relative biological effectiveness (RBE) of 3.5 at 50% survival. The transformation frequency increased exponentially with dose in the range examined (25 to 250 rad); the maximum RBE for the induction of transformation

is growing cells was approximately 3. The RBE for alpha transformation in nonproliferating cells, however, appeared to be much higher; the yield of transformants among x-irradiated cells held in the stationary phase of growth for 6 to 220 h after irradiation declined nearly 5-fold while no decrease occurred in alpha-irradiated cells. This finding supports the hypothesis that carcinogenic damage induced by high LET radiation in mammalian cells is inefficiently repaired compared with x-ray damage, and that the carcinogenic effect of exposures to high LET radiation may be simply cumulative in nature. It further suggests that the effective RBE for alpha radiation in nonproliferating cell populations in vivo may be much higher than one would predict based on measurements in dividing cells.

25100 **Life shortening in BALB/c mice following brief, protracted, or fractionated exposures to neutrons.** Storer, J.B.; Ullrich, R.L. (Oak Ridge National Lab., TN). *Radiation Research;* **96**: No. 2, 335-347(Nov 1983). Contract W-7405-ENG-26.

The effects of acute, protracted, or fractionated exposures to fission neutrons on survival times of female BALB/c mice were examined and compared. Mice were given single, brief exposures or exposures given in equal fractions at either 1- or 30-day intervals to doses of 0, 2.5, 5, 10, 20, 50, and 200 rad at the Health Physics Research Reactor (HPRR) or protracted exposures at rates ranging from 0.1 to 10 rad/day using a moderated ^{252}Cf source to doses of 0, 2.5, 5, 10, 20, and 40 rad. After single or fractionated exposures the extent of life shortening increased rapidly over the 0 to 50 rad range and then began the plateau. No simple model adequately described the dose response over this entire dose range. No increase in effectiveness after fractionation or protraction was observed for neutron-induced life shortening at doses below 50 rad, while at 50 and 200 rad an increase in effectiveness was observed in this and in previous studies. These data were interpreted to suggest that in the dose range below 20 to 40 rad the dose-effect curve for life shortening may be linear and begins to flatten at higher doses rather than continuously bending at low doses.

25101 **Caffeine-enhanced survival of radiation-sensitive, repair-deficient Chinese hamster cells.** Utsumi, H.; Elkind, M.M. (Argonne National Lab., IL). *Radiation Research;* **96**: No. 2, 348-358(Nov 1983). Contract W-31-109-ENG-38.

A clone of V79 Chinese hamster cells (V79-AL162/S-10) with unique properties has been isolated after a challenge of parental cells (V79-AL162) with 1 mM ouabain. Compared with parental cells, or with other clones isolated after the ouabain challenge, these cells form smaller colonies, are more sensitive to both x rays and fission-spectrum neutrons, and respond atypically to a postirradiation treatment with caffeine. Their enhanced response to x rays results mainly from a large reduction in the shoulder of their survival curve, probably because in late S phase, the most resistant phase in the cell cycle, the survival curve of these cells has a reduced shoulder width. Caffeine, and to a lesser extent theophylline, added to the colony-forming medium immediately after exposure appreciably increases the width of the shoulder of these sensitive cells, whereas caffeine has the opposite effect on the response of normal V79 cells. Thus the unique response of the V79-AL162/S-10 cells to a radiation posttreatment with caffeine (increased survival) results from a net increase in their ability to repair damage that is otherwise lethal; caffeine treatment ordinarily prevents normal V79 cells from repairing damage that is only potentially lethal.

25102 **Immune function in aging atomic bomb survivors residing in the United States.** Bloom, E.T. (VA West Los Angeles Medical Center, Los Angeles, CA); Korn, E.L.; Takasugi, M.; Toji, D.S.; Onari, K.; Makinodan, T. *Radiation Research;* **96**: No. 2, 399-410(Nov 1983).

Immunologic parameters were studied among survivors of the 1945 atomic bombs who now reside in the United States. Of all known survivors living in the US, about 40% (n = 189) participated in this study. Of those survivors on whom radiation exposure information was available (n = 168), 96% were exposed to less than 50 rad at the time of the bomb (ATB). Survivors were divided into two groups; those exposed to varying low doses of radiation (S/sub +/ group, exposed at $\leqq$ 2500 m from the hypocenter) were compared with those exposed to 0 rad (S_0 group, exposed at $>$ 2500 m from the hypocenter). Of the former group, 92% were exposed to less than 100 rad and 89% to less than 50 rad ATB. Cellular immune responses, including natural cell-mediated cytotoxicity (NCMC), interferon production, and the mitogenic response to PHA, tended to be higher among S/sub +/ individuals, although only the different for NCMC was statistically significant. This was suggestive of a trend which was consistent with the higher serum interferon levels and lower frequencies of detectable immune complexes and antimitochondrial antibodies among the S/sub +/ group, although these differences were not statistically significant.

25103 **Comparison of observed and predicted normalized particulate air concentrations.** Yildiran, M.; Miller, C.W. (Oak Ridge National Laboratory, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **45**: 54-55(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

25104 **Estimation of risk of cancer induction in populations exposed to low-level radiation.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA). *Investigative Radiology;* **17**: No. 4, 342-349(Jul-Aug 1982). Contract W-7405-ENG-48.

From Annual meeting of the Health Physics Society; Las Vegas, NV, USA (Jun 1981).

Two main questions confronted the BEIR-III Committee from the outset. First, in the consideration of members of the public and public health policy, will radiation effects be expected to occur at dose levels occurring from annual exposure of a few hundred millirems (or a few millisieverts [mSv]) in addition to natural background and medical exposure. The BEIR-III Committee concluded that, in most cases, linear extrapolation from high-dose data leads to overestimation of risk from low-dose, low-LET radiation. The linear model is not likely to overestimate the effects of high-LET radiation, and may, in fact, underestimate them when high-dose data are in the cell-killing dose region. Second, for the radiation worker population in industry and medicine, will delayed or late health effects occur at levels of exposure in the range of 0.5 to 5 rems per year (or 5 to 50 mSv per year). Here the BEIR-III Committee concluded that delayed health effects could occur in those radiation workers with lifetime occupational exposures which may be accumulated by continuously working close to the recommended dose limits, i.e., to the maximum permissible dose.

25105 **Problems and solutions in the estimation of genetic risks from radiation and chemicals.** Russell, W.L. (Biology Division, Oak Ridge National Lab., Oak Ridge, TN 37830). pp 361-384 of Measurement of risks. Berg, G.G.; Maillie, H.D. New York, NY; Plenum Publishing Corp. (1981). (CONF-800601—). Contract W-7405-ENG-26.

From 13. Rochester international conference on environmental toxicity--measurement of risks; Rochester, NY, USA (2 Jun 1980).

This chapter focuses on the methods of measuring genetic risks, the rationale for their choice, problems and solutions in interpreting the results, gaps in knowledge, and future possibilities for better estimation of risks. Reports on extensive investigations with mice on the effects of various physical and biological factors, such as dose rate, sex and cell stage, on radiation-induced mutation which provide an evaluation of the genetics hazards of radiation in man. Supplements the studies on mutation frequency with investigations on the phenotypic effects of mutations in mice, particularly anatomical disorders of the skeleton, which allow an estimation of the degree of human handicap associated with the occurrence of parallel defects in man. Finds that results on transmitted mutations in mice indicate a poor correlation with mutation induction in nonmammalian organisms. Proposes that further investigation on mice is needed, not only on the screening for mutagenicity of other chemicals, but also on the nature of the mutagenic action of ethylnitrosourea.

5603 Chemicals Metabolism And Toxicity

25106 XAD-2 resin method for efficient extraction of mutagens from fried ground beef. Bjeldanes, L.F. (Univ. of California, Berkeley); Grose, K.R.; Davis, P.H.; Stuermer, D.H.; Healy, S.K.; Felton, J.S. *Mutation Research;* **105**: 43-49(1982). Contract W-7405-ENG-48.

4 methods of extraction of mutagens from fried ground beef were compared for total mutagen recovery and chromatographic profile of isolated substances. A method which employs Amberlite XAD-2 resin to isolate mutagenic activity from an initial aqueous acid extract of fried beef was found to yield approx. 4 times more activity than other aqueous or organic solvent extraction procedures. Chromatographic profiles of mutagenic extracts isolated by the 4 methods suggest that the XAD-2 resin method does not recover different mutagens, but is primarily a more efficient isolation procedure. The resin method is rapid, inexpensive, simple, and requires approx. half the time of the other methods.

25107 Biological effects of acidic precipitation on vegetation. Evans, L.S. (Manhattan Coll., The Bronx, NY). pp 137-156 of California symposium on acid precipitation. San Francisco, CA; California Air Resources Board (1981). (CONF-810131—). Contract AC02-76CH00016.

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

Precipitation acidity is discussed in relation to damage to terrestrial vegetation. Experimental research to date has shown that plant response can vary greatly depending on the species, the environment, and the method of exposure. A review of various research projects is presented in order to study the impacts of acidic precipitation of different plant species. From this approach an overall picture of which plant groups are most sensitive and the types of injury which occur is beginning to emerge. At the present time there is little unequivocal evidence that acid precipitation, at ambient levels, is having deleterious effects upon terrestrial vegetation within the US. Although decreases in yields of various crops have been documented in controlled-environment and field experiments at pH levels below 4.0, only well designed field experiments will document changes in plant productivity or survival that may be expected from actual acidic rain exposures. In order to standardize results from future experiments, a uniform expression of data should be utilized.

25108 Some effects of acid precipitation on plants and soils. Firestone, M.K. (Univ. of California, Berkeley). pp 233-244 of California symposium on acid precipitation. San Francisco, CA; California Air Resources Board (1981). (CONF-810131—).

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

Experimental studies on plants, soils, and nutrient cycling processes in the soil are described. A number of different types of soils in California were tested to determine the effect of acid precipitation on cation mobility in soils. The testing was performed by taking samples of surface soils and leaching them with various pH solutions, and analyzing the ionic composition of the leachate. The leaching of Al, Ca, Mg, and K was reported. Tests were performed to investigate the effects of acid precipitation on clover and barley production. The changes which occurred in leaf surface characteristics were also noted. The effects of acid inputs on soil microbial activity were also investigated. Results show an increase in yields of clover and barley with an increase in acid input. Necrotic spots were observed on clover and barley leaves from pH 2 treatment, but none were noted at pH 3. Microbial activity was significantly altered in the planted soil systems, most likely resulting from the improved plant growth in the lower pH treatments.

57 Health And Safety

REFER ALSO TO CITATION(S) 25064

58 GEOSCIENCES

5802 Geophysics

REFER ALSO TO CITATION(S) 24631, 25061

25109 (UCRL—90537) Flow path delineation using Alterant Geophysical Tomography. Ramirez, A.L.; Lytle, R.J. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 11p. (CONF-840633—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009537.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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We describe and evaluate a cross-hole geophysical technique used to map flowpaths in fractured rock: Alterant Geophysical Tomography (AGT). The method involves the use of tracers to change the electrical properties of permeable fractures. Measurements of the electromagnetic attenuation factor of a region are performed at various times (before, during, and after the introduction of the tracer). Changes in the medium due to the tracer are determined by subtracting an inversion representative of baseline conditions from an inversion of data obtained after the tracer has caused changes in the rockmass. This method has been used in a granitic rock mass in an attempt to delineate the flow paths followed by the tracers. Comparisons of the alterant geophysical tomography images with fracture information obtained from acoustic televiewer logs have been made. These comparisons suggest that several of the AGT image anomalies appear to be associated with fractures observed in the acoustic televiewer logs. The AGT method appears to provide several advantages including: increased contrast between the fractures and surrounding rock, sensitivity to only those fractures filled by the tracer and possible improvements in the accuracy of the electromagnetic measurements. 8 references, 2 figures.

25110 (USGS-OFR—83-66) Complete data listings for CSEM soundings on Kilauea Volcano, Hawaii. Kauahikaua, J.; Jackson, D.B.; Zablocki, C.J. (Geological Survey, Hawaii National Park, HI (USA). Hawaiian Volcano Observatory). 1983. 49p. NTIS, PC A03/MF A01. Order Number DE84900995.

This document contains complete data from a controlled-source electromagnetic (CSEM) sounding/mapping project at Kilauea volcano, Hawaii. The data were obtained at 46 locations about a fixed-location, horizontal, polygonal loop source in the summit area of the volcano. The data consist of magnetic field amplitudes and phases at excitation frequencies between 0.04 and 8 Hz. The vector components were measured in a cylindrical coordinate system centered on the loop source. 5 references.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 24925

25111 (LA-UR—84-829) Criterion for quasibrittle crack growth. Margolin, L.G.; Smith, B.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-840633—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010052.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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An expression to predict the onset of growth of a crack in a quasibrittle material is derived. An energy criterion essentially equivalent to the first two laws of thermodynamics is employed. The criterion is applied to the elastic-plastic crack of Olesiak and Wnuk (1968). 12 references, 3 figures. (ACR)

25112 **(LBL—17491) Mechanical transport in two-dimensional networks of fractures.** Endo, H.K. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010708.

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The objectives of this research are to evaluate directional mechanical transport parameters for anisotropic fracture systems, and to determine if fracture systems behave like equivalent porous media. The tracer experiments used to measure directional tortuosity, longitudinal geometric dispersivity, and hydraulic effective porosity are conducted with a uniform flow field and measurements are made from the fluid flowing within a test section where linear length of travel is constant. Since fluid flow and mechanical transport are coupled processes, the directional variations of specific discharge and hydraulic effective porosity are measured in regions with constant hydraulic gradients to evaluate porous medium equivalence for the two processes, respectively. If the fracture region behaves like an equivalent porous medium, the system has the following stable properties: (1) specific discharge is uniform in any direction and can be predicted from a permeability tensor; and (2) hydraulic effective porosity is directionally stable. Fracture systems with two parallel sets of continuous fractures satisfy criterion 1. However, in these systems hydraulic effective porosity is directionally dependent, and thus, criterion 2 is violated. Thus, for some fracture systems, fluid flow can be predicted using porous media assumptions, but it may not be possible to predict transport using porous media assumptions. Two discontinuous fracture systems were studied which satisfied both criteria. Hydraulic effective porosity for both systems has a value between rock effective porosity and total porosity. A length-density analysis (LDS) of Canadian fracture data shows that porous media equivalence for fluid flow and transport is likely when systems have narrow aperture distributions. 54 references, 90 figures, 7 tables.

25113 **(SAND—83-2506) Method for defining the distribution of triaxial stress states in underground structures.** Butcher, B.M.; Hill, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010591.

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A method for defining the distribution of triaxial stress states in three-dimensional underground structures is described. The reason for interest in the degree of triaxiality is that one of the ways to evaluate how well a particular constitutive model correctly predicts stress states in the underground structure is by comparison with laboratory results, i.e. laboratory tests should be undertaken which simulate as closely as possible the dominant triaxial stress paths and end states the underground structure is likely to encounter during service. Thus, the dominant triaxial states of a particular application must be defined in order to permit constitutive model evaluation. The method is illustrated by examination of the solution from a preliminary stress analysis of a complex drift configuration at the bottom of a deep shaft in a proposed underground testing facility. In this example the dominant triaxial states depend very strongly on the assumed in situ stress state and are quite distinct from stress states normally considered in laboratory testing. A method of showing the distribution of stress states is shown, as well as discussion of how this information can be used to plan a constitutive model development program.

25114 **(UCRL—89946) Using sonic technique to estimate in situ stresses.** Mao, N.; Sweeney, J.; Hanson, J.; Costantino, M. (Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 13p. (CONF-840633—2). NTIS, PC A02/MF A01. Order Number DE84002791.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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At present, the only technique available for in situ stress measurements in a borehole at depths over 320 m is hydraulic fracturing. This is a very time consuming, costly technique. An alternative or complementary technique to hydraulic fracturing for measuring in situ stress at depth in a borehole is not only desirable but necessary. It has been known for some time that the velocity of propagation of ultrasonic waves is stress dependent. The velocity of a compressional wave is strongly affected by stress if the stress direction is parallel to the propagation direction. The velocity of shear waves is strongly affected by stress if the direction of applied stress is parallel to the polarization direction. In particular, the shear wave will, in general, be resolved into two components with orthogonal polarization vectors and difference velocities if the material is stressed. This phenomenon is called acoustic double refraction or acoustic birefringence. Conversely, it may be possible to infer stresses from the stress-induced velocity anisotropy in a rock mass. 7 figures.

5804 Geochemistry

REFER ALSO TO CITATION(S) 24946

64 PHYSICS. I.

6402 Atmospheric Physics

25115 **(LA-UR—84-892) Investigation of laminar shocks.** Lee, K.; Aldrich, C.H.; Bame, S.J.; Forslund, D.W.; Gary, S.P.; Gosling, J.T.; Quest, K.B.; Thomsen, M.F.; Winske, D.; Mellott, M.M. (Los Alamos National Lab., NM (USA); Iowa Univ., Iowa City (USA)). 3 Jul 1984. Contract W-7405-ENG-36. 5p. (CONF-840616—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010074.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

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Studies of laminar shocks based on ISEE observations of terrestrial bow shocks, simulation, and theory are presented.

25116 **(LA-UR—84-1067) Soliton collapse during ionospheric heating.** Sheerin, J.P.; Nicholson, D.R.; Payne, G.L.; Duncan, L.M. (Los Alamos National Lab., NM (USA); Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1984. Contract W-7405-ENG-36. 5p. (CONF-840616—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009994.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

We present analytical and numerical work which indicates that during ionospheric heating with high-powered hf radio waves, the oscillating two-stream instability may dominate the parametric decay instability. The oscillating two-stream instability saturates nonlinearly through the formation of solitons which undergo a collisionally damped collapse. Using the heater and radar facilities at Arecibo Observatory, we have investigated this phenomenon experimentally. Recent results from our theoretical and experimental investigations are presented.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 24937, 24940, 24987, 25008, 25171

25117 (BNL—51714, pp 134-136) **Crossed beam studies of proton transfer reactions at low energy.** Farrar, J.M. (Univ. of Rochester, NY). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

The identification of a large number of ionic species in hydrocarbon flames has prompted numerous mass spectral investigations of the chemistry of such flames, with particualr emphasis on the oxygen-methane flame. A recent study of this system underscores the importance of gas phase proton transfer reactions in determining the ionic chemistry of such flames. Furthermore, identification of charged species in flames generated by proton transfer to neutral species created by rapid reactions of free radicals provides an important probe of underlying neutral chemistry. The reactions which initiate ionic chemistry in flames are still uncertain, but the HCO^+ cation is generally accepted as a primary reagent HCO^+ is

well-known to be present in hydrocarbon flames in concentrations exceeding 10^8 cm^{-3} and the moderate proton affinity of CO (142 kcal $mole^{-1}$) makes proton transfer reactions of HCO^+ to a wide variety of substrates exothermic and therefore facile. One of the most important reactions which HCO^+ undergoes in the burnt gas region of O_2/CH_4 premixed flames is proton transfer to H_2O, yielding the hydronium ion, H_3O^+. Because of the known high concentrations of HCO^+ and H_3O^+ in hydrocarbon flames and the fact that their proton transfer reactions to neutrals such as CH_3OH, C_2H_5OH, $(CH_3)_2C=O$, and HCHO, known to be present in the O_2/CH_4 premixed flame, are strongly exothermic, we have focused attention on reactive scattering studies of the dynamics of their proton transfer chemistry. Our research employs the crossed ion beam-molecular beam technique to assess the dynamics of proton transfer reactions by measuring product angular and kinetic energy distributions as a function of initial collision energy in the range from 0.5 eV to 5 eV. 4 references, 1 figure.

25118 (BNL—51714, pp 158-160) **Laser studies of the dynamics of atom molecule reactions.** Jackson, W.M. (Howard Univ., Washington, DC). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

25119 **(DOE/ER/10978—8) Saturation properties of the SF_6 quasicontinuum.** Kwok, H.S. (State Univ. of New York, Buffalo (USA). Dept. of Electrical and Computer Engineering). 1984. Contract AC02-81ER10978. 6p. (CONF-840629—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008224.

From 13. international quantum electronics conference; Anaheim, CA, USA (18 Jun 1984).

A rate equation model calculation incorporating the homogeneous broadening due to intramolecular relaxation within the quasicontinuum was performed. Using a T_2 time of 6 ps, the calculation agrees well with the experimental results obtained using picosecond CO_2 laser pulses.

25120 **Collisional ionization between fast alkali atoms and hexafluorobenzene.** Compton, R.N.; Reinhardt, P.W. (Oak Ridge National Lab., TN). *Chemical Physics Letters;* **91**: No. 4, 268-270(17 Sep 1982). Contract W-7405-ENG-26.

The formation of negative ions through collisions between alkali atoms and hexafluorobenzene (C_6F_6) is studied. Unlike all other systems studied to date the charge-transfer cross section producing $C_6F_6^-$ is very small. A possible explanation for this anomaly is presented based upon competition with the fluorine abstraction reaction. 2 figures.

25121 **Spectra of chemical trees.** Balasubramanian, K. (Lawrence Berkeley Lab., CA). *International Journal of Quantum Chemistry;* **21**: 581-590(1982). Contract W-7405-ENG-48.

A method is developed for obtaining the spectra of trees of NMR and chemical interests. The characteristic polynomials of branched trees can be obtained in terms of the characteristic polynomials of unbranched trees and branches by pruning the tree at the joints. The unbranched trees can also be broken down further until a tree containing just two vertices is obtained. The effectively reduces the order of the secular determinant of the tree used at the beginning to determinants of orders atmost equal to the number of vertices in the branch containing the largest number of vertices. An illustrative example of a NMR graph is given for which the 22 x 22 secular determinant is reduced to determinants of orders atmost 4 x 4 in just the second step of the algorithm. The tree pruning algorithm can be applied even to trees with no symmetry elements and such a factoring can be achieved. Methods developed here can be elegantly used to find if two trees are cospectral and to construct cospectral trees.

25122 **Algorithm for the generation of nuclear spin species and nuclear spin statistical weights.** Balasubramanian, K. (Lawrence Berkeley Lab., CA). *Journal of Computational Chemistry;* **3**: No. 1, 69-74(1982).

A set of algorithms for the computer generation of nuclear spin species and nuclear spin statistical weights potentially useful in molecular spectroscopy is developed. These algorithms generate the nuclear spin species from group structures known as generalized character cycle indices (GCCIs). Thus the required input for these algorithms is just the set of all GCCIs for the symmetry group of the molecule which can be computed easily from the character table. The algorithms are executed and illustrated with examples.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 25150

25123 **(ANL—84-5) Stability of tubes conveying fluid.** Chen, S.S.; Jendrzejczyk, J.A. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 46p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010573.

Tests and analysis are made for tubes conveying fluid for two types of support conditions. The objectives are to study the characteristics of different types of instability, the transition of one instability mechanism to another, and the control of instability.

25124 **(DOE/ER/72012—T1) CALTECH - DOE program on numerical anlaysis, computing and fundamental studies of motion, energy and mass transfer in fluids. Summary report No. 10: April 1, 1983-March 31, 1984.** (California Inst. of Tech., Pasadena (USA)). 1984. Contract AT03-76ER72012. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008935.

Research is summarized for flow in porous media, finite amplitude waves in viscous shear flow, vortex induced lift, vortex dynamics, curvilinear grids, Taylor vortex flows, and the Dean problem of steady viscous flow in a uniformly curved tube. (GHT)

25125 **(UCRL—90449) Another attempt to overcome the bent element blues.** Gresho, P.M.; Leone, J.M. Jr. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 15p. (CONF-840688—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007785.

From 5. international conference on finite elements in water resources; Burlington, VT, USA (18 Jun 1984).

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This paper is the second of a pair in which we attempt, mostly unsuccessfully, to patch a perceived defect in the Galerkin finite element approximations to the pressure gradient. The first was presented earlier this year (Gresho, et al. (1984a)). specifically, we address the problems associated with the bilinear velocity, piecewise-constant pressure element for solving the incompressible Navier-Stokes equations. When the discrete approximation to gradient of P is examined on a mesh of distorted elements (via the bilinear isoparametric mapping), it appears to be not very accurate; from a Taylor series viewpoint, this element is not meant to be bent. After exposing these alleged defects, we proceed to patch the gradient approximation. In the limited context of our techniques used to integrate the time-dependent equations, we discuss and demonstrate the advantages of the new approximation. But we also discuss the numerous disadvantages uncovered during our investigation and, in the end, admit failure - and we continue to sing the Bent Element Blues.

6450 High Energy Physics

25126 **(SLAC—267) Dynamics and spectroscopy at high energy. Proceedings of summer institute on particle physics.** McDonough, P.M. (ed.). (Stanford Linear Accelerator Center, CA (USA)). Jan 1984. Contract AC03-76SF00515. 805p. (CONF-8307109—). NTIS, PC A99; 3; GPO Dep. Order Number DE84008968.

From 11. SLAC summer institute conference on particle physics - dynamics and spectroscopy at high energy; Stanford, CA, USA (18 Jul 1983).

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The eleventh SLAC Summer Institute on Particle Physics was held from July 18 to July 29, 1983, and the traditional format was followed of having the first seven days as a Summer School and the last three as a Topical Conference. The school portion was devoted to lectures on spectroscopy of heavy quark systems and jets from both an experimental and theoretical point of view together with lectures on the physics and technology of charged particle tracking and calorimetry. The Topical Conference highlights included reports on the discovery of the W and Z at the CERN anti p p collider. The attendance of 327 physicists from 15 countries, the excellent lectures, and the exciting physics made for a very interesting and lively meeting. Separate abstracts were prepared for the 30 papers presented. (WHK)

6451 Particle Interactions And Properties - Experimental

25127 **(BNL—34513) Physics signatures at the SSC.** Paige, F.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 55p. (CONF-840275—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84008804.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

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The extrapolation based on the standard model from previous data to the S anti ppS has been quite successful. However, the extrapolation from the S anti ppS to the SSC is substantially greater. In terms of mass, the former extrapolation was from M $\approx$ 30 GeV at PETRA, PEP, and the ISR to M $\approx$ 100 GeV at the S anti ppS. The extrapolation for the SSC is from M $\approx$ 100 GeV to M $\approx$ 1000-10,000 GeV. In addition there is an extrapolation in x. The typical x value at the S anti ppS is x $\approx$ m/sub W/s = 0.15, while for the SSC many processes of interest have x $<$ 0.01. This does not mean that one should dispair or should ignore the theoretical predictions, but some degree of caution is in order.

25128 **(DOE/ER/70107—T3) Progress report, November 1, 1982-October 31, 1983.** Kernan, A.; Shen, B.C. (California Univ., Riverside (USA)). 1983. Contract AT03-76ER70107. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008841.

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Progress is briefly described on experiment PEP-4 including a description of the time projection chamber facility. Also, progress on experiment UA1 (p anti p interactions at C.M. energy 540 GeV) is briefly discussed, including the discovery of the Z^0 and W/sup +-/ bosons. Publications and reports are listed. (WHK)

25129 **(LA-UR—84-826) XIX Recontre de Moriond. Summary talk.** Rosen, S.P. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 23p. (CONF-840150—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010053.

From 4. Moriond workshop on massive neutrinos in particle and astro-physics; La Plagne, France (15 Jan 1984).

The theoretical arguments for neutrino mass are reviewed, and the present status of searches for neutrino mass in neutrino oscillations, direct measurements and other experiments are summarized. 46 references.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 25129, 25137

25130 **(DOE/ER/02009—148) Indiana University Theoretical Particle Physics Group. Final report, December 1, 1970-October 31, 1983.** Hendry, A.W.; Lichtenberg, D.B.; Weingarten, D.H. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1983. Contract AC02-76ER02009. 23p. (COO—2009-148). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010593.

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We have carried out a broad program of research to understand aspects of the interactions of nature on both theoretical and phenomenological levels. Our research has led to the publication of about 130 papers; these paper are listed. We also have worked closely with the members of the high energy experimental group to give them theoretical support and to help in interpretation of their experiments. A brief summary of accomplishments is given. (WHK)

25131 **Glueballs and meiktons which decay to multi-kaon final states.** Chanowitz, M.S.; Sharpe, S.R. (Lawrence Berkeley Lab., CA). *Physics Letters,* [*Section*] *B;* **132**: No. 4-6, 413-418(1 Dec 1983).

We observe in the usual spherical cavity approximation to the bag model that TM gluon modes couple predominantly in the s-channel to anti ss quarks. We compute the spectrum of glueballs and meiktons containing TM gluons, which have unique decays to states of two, three, or four kaons.

25132 **Model dependence of the matrix elements of the $\Delta B = 2$ six-quark operators in neutron-antineutron transitions.** Fajfer, S.; Oakes, R.J. (Northwestern Univ., Evanston, IL). *Physics Letters,* [*Section*] *B;* **132**: No. 4-6, 433-435(1 Dec 1983).

To investigate their model dependence, the matrix elements of the six independent $\Delta B=2$ six-quark operators, which enter in neutron-antineutron transitions, were evaluated using the neutron wave functions in the relativistic potential model and in the harmonic oscillator shell model. The results were compared with the corresponding values previously calculated in the MIT bag model and the matrix elements were found to be very sensitive to the model used for the neutron wave function, some differing not only by more than an order of magnitude but also in sign.

25133 **High-energy pion-proton elastic scattering and the pion form factor.** Bourrely, C.; Chiappetta, P.; Soffer, J.; Wu, T.T. (Centre National de la Rescerche Scientifique, 13 - Marseille, France). *Physics Letters,* [*Section*] *B;* **132**: No. 1-3, 191-194(24 Nov 1983). Contract AC02-76ER03227.

Recent data on π p elastic scattering at 200 GeV/c from Fermilab allow a further application of the Chou-Yang relation between scattering amplitudes and form factors. Using a carefully selected parametrization of the elastic amplitude, we find that the pion form factor has a zero for vertical stroketvertical stroke between 15 and 20 $(GeV)^2$. In order to locate this zero accurately, more experimental data at large momentum transfers are needed.

25134 **Production of gauge-fermions at colliders.** Barger, V.; Robinett, R.W.; Keung, W.J.; Phillips, R.J.N. (Wisconsin Univ., Madison). *Physics Letters,* [*Section*] *B;* **131**: No. 4-6, 372-376(17 Nov 1983).

The gauge fermions of supersymmetry can be produced at anti pp, pp and e^+e^- colliders, via the exchange of supersymmetric scalar particles and via Wsup(+-), γ and Z^0 direct channel diagrams. We give expressions for amplitudes of γ tildeω^+ and $\omega^+\omega^-$ production in quark-antiquark collisions and $\omega^+\omega^-$ production in e^+e^- collisions, where γ tilde and ω^+ are gauge fermion mass eigenstates. In the supersymmetry limit gauge amplitude zeros appear in the uanti d->g tildeω^+ amplitudes. Integrated rates are given for a light γ tilde and representative ω and scalar masses.

6453 Particle Invariance Principles And Symmetries

25135 **Supersymmetry breaking without O'Raifeartaigh potentials.** Ovrut, B.A.; Raby, S. (Rockefeller Univ., New York). *Physics Letters,* [*Section*] *B;* **134**: No. 1/2, 51-55(5 Jan 1984).

We show that spontaneous supersymmetry breaking through F-terms can occur in locally supersymmetric theories whose superpotentials are not of the O'Raifeartaigh type. The supersymmetry breaking vacuum states can be fine tuned to have vanishing cosmological constant.

6454 Field Theory

REFER ALSO TO CITATION(S) 25135

25136 **Strong-coupling approximation in supersymmetric field theory.** Bender, C.M.; Das, A.; Lim, H.A.; Simmons, L.M. Jr. (Washington Univ., St. Louis, MO). *Physics Letters, [Section] B;* **134**: No. 3/4, 225-229(12 Jan 1984).

We show how to use the lattice strong-coupling approximation in a wide class of two-dimensional supersymmetric field theories. We demonstrate that this technique is highly accurate for supersymmetric theories by calculating the ground-state energy density E_0 through seventh order in perturbation theory and by showing that the result approaches the correct supersymmetric limit $E_0 = 0$. We argue that, by their nature, strong-coupling methods are especially well-suited for practical calculation in supersymmetric theories.

25137 **General two-loop analysis of SO(10) symmetry breaking with one intermediate scale. Neutral-current couplings and proton decay.** Ma, E.; Whisnant, K. (Hawaii Univ., Honolulu). *Physics Letters, [Section] B;* **131**: No. 4-6, 343-347(17 Nov 1983). Contract AM03-76SF00235;W-7405-ENG-82.

We analyze all possible patterns of symmetry breaking from SO(10) to SU(3)sub(c)xSU(2)sub(L)xU(1)sub(Y) in the left-right decomposition with one intermediate energy scale. We use two-loop renormalization-group equations to find the allowed neutral-current couplings at low energy in each case, and compare these with experiment to deduce the allowed domains for the intermediate and grand-unification energy scales, from which we estimate the allowed range of lifetimes for proton decay.

25138 **Covariant lattice glueball fields.** Mandula, J.E.; Zweig, G.; Govaerts, J. (Washington Univ., St. Louis, MO). *Nuclear Physics [Section] B;* **228**: No. 1, 109-121(15 Nov 1983).

Fields for the creation and annihilation of gluons and glueballs, which transform irreducibly under the four-dimensional lattice rotation reflection and charge conjugation symmetry groups, are defined and discussed. The fields reduce in the zero lattice spacing limit to conventional continuum operators of definite spin, parity, and charge conjugation.

25139 **Constrained quenched master field for continuum QCD.** Halpern, M.B. (Lawrence Berkeley Lab., CA). *Nuclear Physics [Section] B;* **228**: No. 1, 173-189(15 Nov 1983).

Stochastic quantization of theories of unitary matrices is achieved via general Langevin-Fokker-Planck systems on group space. Lattice gauge theories and large-N quenching are discussed. Emphasis is on a new Langevin equation for the Gross-Kitazawa constrained gluon. Total (space-time) quenching is demonstrated to all orders for this field, resulting in an algebraic master equation for a properly constrained quenched master field for continuum QCD.

65 PHYSICS. II.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

25140 **(ORNL/TM—9049) Fission-product yields for thermal-neutron fission of ^{243}Cm determined from measurements with a high-resolution low-energy germanium gamma-ray detector.** Merriman, L.D. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010634.

Cumulative fission-product yields have been determined for 13 gamma rays emitted during the decay of 12 fission products created by thermal-neutron fission of ^{243}Cm. A high-resolution low-energy germanium detector was used to measure the pulse-height spectra of gamma rays emitted from a 77-nanogram sample of ^{243}Cm after the sample had been irradiated by thermal neutrons. Analysis of the data resulted in the identification and matching of gamma-ray energies and half-lives to individual radioisotopes. From these results, 12 cumulative fission product yields were deduced for radionuclides with half-lives between 4.2 min and 84.2 min. 7 references.

6530 Nuclear Theory

25141 **(CONF-8403101—3) Initial energy density of quark-gluon plasma in relativistic heavy-ion collisions.** Wong, C.Y. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008510.

From 3. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (5 Mar 1984).

Recently, there has been considerable interest in the central rapidity region of highly relativistic heavy-ion collisions. Such an interest stems from the possibility of creating hadron matter of high energy density which may exceed the critical energy density for a phase transition between ordinary confined matter and the unconfined quark-gluon plasma. The experimental searches and identification of the quark-gluon plasma may provide a new insight into the question of quark confinement. The estimate of the initial energy density is quite uncertain. The initial energy density is nonetheless an important physical quantity. It is one of the factors which determines whether the produced matter can undergo phase transition or not. The energy density has been estimated previously by using the color neutralization model of Brodsky et al. However, the color neutralization model gives a central rapidity multiplicity in heavy-ion collision too low by a factor of two. For this reason, we wish to obtain a better estimate of the energy density (in the central rapidity region). As is well known, a simple Glauber-type multiple collision model can reproduce the total multiplicity and multiplicity plateau near the central rapidity region to within 30%. The simple multiple collision model has an approximate validity as a gross description of the reaction process. We shall adopt a semiempirical approach. Using the multiple collision model and the thickness function of Glauber, we obtain analytical functional form for all the quantities in question. A single parameter, r/sub rms/, is adjusted to fit the experimental central rapidity multiplicity data. The semi-empirical results provide a useful tool to extrapolate to the unknown central rapidity region of heavy-ion collisions.

6540 Radiation And Shielding Physics

25142 **(CONF-840264—4) Introduction to neutron scattering by magnetic excitations.** Mook, H.A. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008579.

From Workshop on high energy excitations in condensed matter; Los Alamos, NM, USA (13 Feb 1984).

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There are a wide variety of magnetic phenomena and measurements provide a test of the many-body theories that are necessary to understand condensed matter physics of all types. Indeed the famous theorem quoted by Van Vleck as Miss van Leeuwen's theorem tells us that classical statistics applied to any metallic system results in no magnetism so that quantum mechanics is necessary to even get started. The magnetic moment of neutrons makes them an excellent probe of magnetic phenomena and very direct information is obtainable with neutrons. In fact the generalized susceptibility is directly given by a neutron scattering experiment, and this quantity tells all there is to know about a magnetic system. The purpose of this paper is to serve as an introduction to a series of papers on magnetic excitations. I will thus establish the necessary neutron scattering formalism so that it will not have to be repeated by each author and discuss briefly various types of magnetic systems.

25143 **(LA—9863-MS) TRANSX-CTR: a code for interfacing MATXS cross-section libraries to nuclear transport codes for fusion systems analysis.** MacFarlane, R.E. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010997.

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TRANSX-CTR is a computer code that reads nuclear data from a library in MATXS format and produces transport tables compatible with many discrete-ordinates (S/sub N/) and diffusion codes. Tables can be produced for neutron, photon, or coupled transport. Options include adjoint tables, mixtures, self-shielding, group collapse, homogenization, thermal upscatter, prompt or steady-state fission, transport corrections, elastic removal corrections, and flexible response-function edits. The ability to prepare coupled tables and response edits for heating, damage, gas production, and delayed activity makes TRANSX-CTR especially useful for fusion reactor studies.

6550 Medical Physics

25144 **Reference dosimetry for the Health Physics Research Reactor.** Sims, C.S.; Patterson, G.R. Jr. (Oak Ridge National Lab., TN). *Health Physics;* **45**: No. 5, 1003-1005(Nov 1983). Contract W-7405-ENG-26.

The Health Physics Research Reactor (HPRR) is the primary research tool at the Oak Ridge National Laboratory's Dosimetry Applications Research Facility. The HPRR is a small, unreflected, unmoderated, fast reactor and has been adequately described in the literature. One item which is missing from the open literature, HPRR reference dosimetry (i.e. definitive dosimetry information which is tied to basic physical parameters and provides the basis on which dosimetric quantities are reproducibly reported), is described here.

6560 Solid State Physics

25145 **Spin waves at surfaces and steps in ferromagnets and antiferromagnets.** Falicov, L.M. (Materials and Molecular Research Division, Lawrence Berkeley Lab. Dept. of Physics, Univ. of CA, Berkeley, CA 94720). pp 489-499 of Excitations in disordered systems. Thorpe, M.F. New York, NY; Plenum Publishing Corp. (1982). (CONF-8109228—). Contract W-7405-ENG-48.

From NATO Advanced Study Institute conference on excitations in disordered systems; East Lansing, MI, USA (4 Sep 1981).

A study of the influence of local spin wave spectra on the magnetic properties of a structure is made. Spectra of the spin wave modes associated with clean and stepped surfaces of a ferromagnet are studied. A model stepped surface unit cell containing 12 atoms in each plane is shown. This cell is based on a Heisenberg Hamiltonian model, with exchange limited to the nearest neighbors. Bulk and surface states, local density of state, and surface local density for a perfect (001) surface are derived. Results for various local densities of magnon states of a stepped surface are also shown. Difficulties encountered when the same procedure is attempted on antiferromagnetic surfaces are considered.

6561 Superconductivity

REFER ALSO TO CITATION(S) 24911

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 25178

6580 Mathematical Physics

25146 **(LBL—17570) Some aspects of the theory of time and band limited operators associated with Lame's equation.** Perline, R.K. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 86p. NTIS, PC A05; 3; GPO Dep. Order Number DE84010711.

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The thesis has three chapters. In Chapter 1, it introduces the Gegenbauer functions and their fundamental properties. Following Grunbaum, it proves that the partial Gram matrix for Gegenbauer's equation admits a commuting tridiagonal matrix. Chapter 2 discusses the rudiments of the theory of the Weierstrass P-function and associated functions, and investigates in some detail the Sturm-Liouville problem for Lame's equation. Chapter 3 is the central chapter of the thesis. After beginning with some algebraic preliminaries concerning the linear equations which determine the existence of a commuting tridiagonal matrix, it presents the non-existence proof for dimension four, as well as the numerical evidence. This chapter concludes with a discussion of some numerical experiments which suggest a means of conducting the spectral analysis of the partial Gram matrix even when no commuting tridiagonal matrix exists. Finally, the appendix describes the algorithms used to evaluate the functions P, σ, and zeta.

25147 **(UCRL—90656) Jacobi splittings and the method of overlapping domains for solving elliptic P.D.E.'s.** Rodrigue, G.; Simon, J. (Lawrence Livermore National Lab., CA (USA)). 2 Apr 1984. Contract W-7405-ENG-48. 6p. (CONF-8406113—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84010556.

From 5. IMACS international symposium; Bethlehem, PA, USA (19 Jun 1984).

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The numerical Schwarz algorithm for solving elliptic partial differential equations is essentially a block Gauss-Siedel method for inverting a matrix equation. The numerical Schwarz algorithm is only one variant of the method of overlapping domains. This method yields matrix equations that are related to the standard systems obtained from elliptic P.D.E.'s. This paper analyzes the use of Jacobi splittings on these matrix equations.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 25170

25148 **Strong coupling effects on plasma lineshapes and Thomson scattering signals.** Boercker, D.B.; Lee, R.W.; Rogers, F.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Journal of Physics B: Atomic and Molecular Physics;* **16**: No. 17, 3279-3290(14 Sep 1983).

The static correlations calculated from the hypernetted chain equation were used for the two-component plasma in a generalized Vlasov equation to estimate the effects of strong plasma coupling on spectral lineshapes and Thomson scattering signals. Thomson scattering was found to be much more sensitive to such effects than the lineshapes.

25149 **Effect of mobilities and electric field on the stability of magnetized positive column.** Dogra, V.K.; Uberoi, M.S. (Colorado Univ., Boulder (USA)). *Plasma Physics;* **25**: No. 8, 937-942(Aug 1983).

The effect of ratio of the mobilities of electrons and ions and non-dimensional electric field, on the stability of magnetized positive column for all unstable modes is studied in a self-consistent formulation for the perturbations of plasma density and electric potential. The minimum non-dimensional electric field at which magnetized positive column becomes unstable for different ratios of the mobilities of electrons and ions is also investigated.

25150 **Anisotropy in MHD turbulence due to a mean magnetic field.** Shebalin, J.V. (Westinghouse Electric Corp., Annapolis, MD (USA). Oceanic Div.); Matthaeus, W.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center); Montgomery, D. (Maryland Univ., College Park (USA)). *Journal of Plasma Physics;* **29**: 525-547(Jun 1983).

The development of anisotropy in an initially isotropic spectrum is studied numerically for two-dimensional magnetohydrodynamic turbulence. The anisotropy develops through the combined effects of an externally imposed d.c. magnetic field and viscous and resistive dissipation at high wavenumbers. The effect is most pronounced at high mechanical and magnetic Reynolds numbers. The anisotropy is greater at the higher wavenumbers.

25151 **Notes on the stability problem for inhomogeneous equilibria.** Symon, K.R. (Los Alamos National Lab., NM (USA)). *Journal of Plasma Physics;* **29**: 275-286(Apr 1983).

Several conclusions regarding the stability of inhomogeneous Vlasov equilibria are drawn from earlier work. A technique is presented for generating first-order formulae for the change deltaω in the frequency of any normal mode, when a parameter lambda characterizing the equilibrium is changed slightly. Several applications are given, including a first-order calculation of the growth rate or damping of an electromagnetic mode due to the presence of plasma. A condition is derived for the existence of a normal mode with real frequency. When there are ignorable co-ordinates, the normal modes can be written in the form of waves propagating in the ignorable directions. The character of the modes depends on certain symmetries in the dynamic spectral matrix. Special cases arise when the orbits can be approximated in certain ways.

25152 **Electrostatic modes in a magnetized plasma with a longitudinal density gradient.** Maggs, J.E.; Morales, G.J. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics; California Univ., Los Angeles (USA). Dept. of Physics). *Journal of Plasma Physics;* **29**: 177-194(Apr 1983).

An analytic study is made of the electrostatic mode structures which exist between the upper-hybrid cut-off and the plasma resonance in a plasma in which the zero-order density gradient points along the magnetic field. In general the solutions consist of long-wavelength cold modes which are converted to short-wavelength Bohm-Gross modes near plasma resonance. However, there exist certain discrete angles of propagation at which finite solutions exist that can be described solely in terms of cold plasma theory. The relevance of these processes to resonant absorption experiments in the auroral ionosphere is considered. A brief study is made of the changes produced by a finite angle between the density gradient and the magnetic field. The possibility of finding analogous low-frequency structures is also investigated.

25153 **Plasma parameters, fluctuations and kinetics in a magnetic field line reconnection experiment.** Wild, N.C. Jr. Los Angeles, CA; Univ. of California (1983). 299p. University Microfilms Order No. 83-14,695.

Thesis (Ph. D.).

The processes associated with reconnecting magnetic field lines have been studied in a large experimental laboratory plasma. Detailed time- and space-resolved probe measurements of the plasma density, temperature, potential and electric and magnetic fields are discussed. Plasma currents are seen to modify the vacuum magnetic field topology. A flat neutral sheet develops along the separatrix where magnetic flux is transferred from regions of private to common flux. Forced tearing and magnetic island formation are also observed. Rapid electron heating, density and temperature nonuniformities and plasma potential gradients are all observed. The pressure is found to peak at the two edges of the neutral sheet. The dissipation E.J is determined and analyzed in terms of particle heating and fluid acceleration. A consistent, detailed picture of the energy flow via Poynting's theorem is also described. Significant temporal fluctuations in the magnetic fields and electron velocity distribution are measured and seen to give rise to anomalously high values for the plasma resistivity, the ion viscosity and the cross-field thermal conductivity. Electron temperature fluctuations, double layers associated with partial current disruptions, and whistler wave magnetic turbulence have all been identified and studied during the course of the reconnection event.

25154 **Investigation of edge neutral flux on the ISX-B tokamak using a low energy charge exchange analyzer.** Thomas, D.M. Austin, TX; Univ. of Texas (1983). 273p. University Microfilms Order No. 83-19,690.

Thesis (Ph. D.).

To study the emission of D^0 from the periphery of a tokamak plasma, a low energy neutral particle spectrometer optimized for ($E < 500$ eV) has been built and employed on the ISX-B tokamak. The diagnostic utilizes a cesium vapor cell to form negative ions from the incident D^0 neutrals, and a 4-channel electrostatic analyzer to energy analyze the negative ions. To minimize cesium contamination of the vacuum system a heat pipe design was used for the vapor cell. The device was absolutely calibrated using D^0 beams from a particle accelerator. Two different techniques for forming low energy neutral beams were employed: electron capture by positive ions in a gas cell, and photodetachment of negative ions by a YAG laser.

25155 **Experimental investigation of high-density plasmas in field-reversed configurations.** Carson, R.S. Seattle, WA; Univ. of Washington (1983). 122p. University Microfilms Order No. 83-19,395.

Thesis (Ph. D.).

In order to reduce particle end-loss from a short, linear, plasma device, closed-field structures have been formed using the technique known as field-reversal in a theta-pinch. The Field-Reversed Configurations (FRC's) produced increase the particle confinement by a factor of three for plasma conditions with electron densities of approximately 2.10^{17} cm^{-3} and temperatures as large as 60 eV. Confining magnetic fields up to 6 T were produced by a solenoid coil.

25156 **Density and potential measurements in an intense ion beam-generated plasma.** Abt, N.E. Berkeley, CA; Univ. of California (1982). 128p. University Microfilms Order No. 83-00,414.

Thesis (Ph. D.).

Neutral beams are created by intense large area ion beams which are neutralized in a gas cell. The interaction of the beam with the gas cell creates a plasma. Such a plasma is studied here. The basic plasma parameters, electron temperature, density, and plasma potential, are measured as a function of beam current and neutral gas pressure. These measurements are compared to a model based on the solution of Poisson's equation. Because of the cylindrical geometry the equation cannot be solved analytically. Details of the numerical method are presented. Three refinements to existing models have been added. (1) The beam creates ions by charge exchange as well as by ionization. (2) In the ionization process most of the ions are born at rest but some of the ions are born through a molecular dissociation process which provides them with substantial energy. (3) Electrons are trapped in the potential well of the system. Their distribution will be truncated by the well and the usual Boltzmann relation for the density variation with potential will be altered slightly. Analytical expressions for these effects are obtained and included in the computer generated solution. The model and data are in good agreement only when locally determined beam current profiles are used in the solution. These profiles are broader than those determined from beam dump calorimetry.

25157 **Axial flow of a collisional plasma through multiple magnetic mirrors.** Bravenec, R.V. Berkeley, CA; Univ. of California (1982). 178p. University Microfilms Order No. 83-00,441.

Thesis (Ph. D.).

The flow of a collisional plasma along a magnetic field is studied, with emphasis on flow through multiple magnetic mirrors. A steady-state analysis of viscous flow through a multiple-mirror device is performed to understand the transition from sonic flow to diffusion with increasing values of λ/l/sub m/ (λ is the ion-ion mean-free-path and l/sub m/ is the mirror scale length). Numerical and experimental studies of transient plasma injection into a multiple-mirror device are presented in order to understand the process by which a collisional plasma is trapped. Steady-state solutions for an isothermal plasma are first given for a uniform field and a single mirror. These results are then used to study flow through a multiple-mirror device. Axial injection of a fluid plasma from a conical theta-pinch into a multiple-mirror device is first studied numerically. An ideal-fluid simulation incorporating high beta (the ratio of plasma pressure to the vacuum magnetic field pressure) is developed and used to study, first, plasma expansion from the theta-pinch into a solenoidal field. Next, injection into multiple mirrors is investigated, where it is found that shock waves form in the mirrors which propagate upstream and thermalize the drift energy.

25158 **Physics and engineering aspects of multiple mirror fusion reactors.** Najmabadi, F. Berkeley, CA; Univ. of California (1982). 206p. University Microfilms Order No. 83-00,600.

Thesis (Ph. D.).

The diffusion model for multiple mirror confinement has previously been limited to devices with a large number of cells and high mirror ratios. Ambipolar effects were assumed to reduce the confinement time by the usual factor $(1 + ZT/\text{sub e}//T/\text{sub j/})^{-1}$. A new stair-case density model, without those limitations, has been developed. A kinetic description for ion and electron transport in a multiple mirror device has been used. A self-consistent ambipolar potential is included. We have found that the ambipolar potential reduces the confinement time somewhat less than the usual ambipolar factor. For machines with a small number of cells, significant improvements in the confinement time have been found. This stair-case density model as well as the diffusion model has been used to study the parameters of a steady state multiple mirror reactor. In general, the stair-case model has been found to result in shorter reactors with higher temperatures and greater number of cells than those found by using the diffusion model. Two different reactor models are introduced: (1) Simple model which is accurate for $Q \geqq 5$ (Q is the ratio of the fusion power to the recirculating power). (2) Detailed model where neutral beam injectors provide the recirculating power; and the velocity distributions of beam and alpha particles are calculated by using a simplified Fokker-Planck equation.

25159 **Tearing modes in tokamak plasmas with and without ion beam driven currents.** Schultz, C.G. Princeton, NJ; Princeton Univ. (1982). 144p. University Microfilms Order No. 83-01,419.

Thesis (Ph. D.).

Several aspects of the magnetohydrodynamic tearing mode have been studied. The structure of the resistive $m = 1$ layer is investigated with quasilinear analysis. For profiles corresponding to ideal-MHD stability, the structure at the $m = 1$ mode is similar to $m \geqq 2$, while for MHD-unstable profiles, the mode structure at the tearing layer turns out to be different and less affected to quasilinear corrections. The quasilinear effect on the growth rate is calculated numerically. For linear shear, a variational prescription to calculate the $M = 1$ tearing growth rates is given both for resistive and for viscous tearing. The effect of a fast ion beam on tearing modes is treated in two limits; when beam-particle gyro-orbits are large, and when they are small. The tearing-layer equations are shown to be higher-order terms in the asymptotic expansion of the force laws in terms of the inverse tearing-layer width. Flows in the invariant direction are related to finite compressibility. Flowpatterns for the $m = 1$ ideal kink mode consist with Newcomb-minimization are explicitly given, indicating singular behavior of flows in the invariant direction at the rational surface.

25160 **Heavy ion beam probe measurements on LITE and EBT.** Bresnock, F.J. Troy, NY; Rensselaer Polytechnic Inst. (1982). 162p. University Microfilms Order No. 83-03,063.

Thesis (Ph. D.).

A Heavy Ion Probe was implemented on two magnetic mirror confinement experiments. In the Laser Initiated Target Experiment (LITE) the probe was developed for an environment which included a complex three dimensional magnetic field, high levels of noise, and extremely short plasma durations. A successful beam alignment was realized, but an unexpectedly low plasma electron temperature prohibited confirmation of the detector signals, although signals were observed under some optimal conditions. In the second experiment, the ELMO Bumpy Torus (EBT) the probe was implemented in one mirror sector of a set of toroidally linked mirror cells. A technique to extend the upper bound of Heavy Ion Probe Temperature measurements by using higher charged states was shown to be feasible. Radial profiles of the temperature in EBT were obtained, and an estimate of the error established. The final error in this measurement was relatively large because of the possibility of charge exchange production of detected ions contributing to the signal.

25161 **ALEX neutral beam probe.** Pourrezaei, K. Troy, NY; Rensselaer Polytechnic Inst. (1982). 211p. University Microfilms Order No. 83-03,078.

Thesis (Ph. D.).

A neutral beam probe capable of measuring plasma space potential in a fully 3-dimensional magnetic field geometry has been developed. This neutral beam was successfully used to measure an arc target plasma contained within the ALEX baseball magnetic coil. A computer simulation of the experiment was performed to refine the experimental design and to develop a numerical model for scaling the ALEX neutral beam probe to other cases of fully 3-dimensional magnetic field. Based on this scaling a 30 to 50 keV neutral cesium beam probe capable of measuring space potential in the thermal barrier region of TMX Upgrade was designed.

25162 **Electron power balance in the tandem mirror Phaedrus.** Yujiri, L. Madison, WI; Univ. of Wisconsin (1982). 323p. University Microfilms Order No. 82-27,003.

Thesis (Ph. D.).

Measurements have been taken of a plasma in the tandem mirror Phaedrus, sustained and heated by RF alone (RF sustained mode), to determine the dominant terms in an electron power balance equation. The ultimate aim of understanding the electron power balance is to determine ways to raise the electron temperature T/sub e/, an important step in improving the performance of the tandem mirror. The results of this study are presented in this thesis.

25163 **Stark broadening in laser-produced plasmas: full Coulomb calculation.** Woltz, L.A. Gainesville, FL; Univ. of Florida (1982). 82p. University Microfilms Order No. 83-02,320.

Thesis (Ph. D.).

This work is a study of the Stark broadening of spectral lines emitted by highly charged ions in a hot, dense plasma. The line broadening calculations of Tighe and Hooper, in which the dipole approximation was used for the interaction between the radiating ions and perturbing electrons, are extended by retaining the full Coulomb radiator-perturbing electron interaction. Electron broadening is treated to second order in the radiator-perturbing electron interaction; ion broadening is treated by a static ion microfield probability distribution. Perturbing electrons are treated quantum mechanically through Coulomb wavefunctions to account for the charged radiator.

25164 **Measurement of shifts and widths of spectral lines in a laser-produced plasma.** Adcock, J.C. Jr. College Park, MD; Univ. of Maryland (1982). 87p. University Microfilms Order No. 83-18,864.

Thesis (Ph. D.).

The shift and broadening of spectral lines in a dense plasma is investigated using a laser-produced plasma. The plasma is produced by the Glass Development Laser at the Laboratory for Laser Energetics at the University of Rochester. The near-ultraviolet (3513 Angstroms) laser beam is focused onto targets of glass and plastic, producing spectra of C VI, O VIII, and F IX. The spectra are observed with a 3-meter grazing-incidence spectrograph. Wavelength calibration is obtained by spectra from heavy metal targets. The theoretical basis for shifts of spectral lines by plasma polariza-

tion effects is discussed, and theoretical estimates are given for Lyman series lines of the above elements.

25165 **Alpha particle driven Alfven wave instability in a tandem mirror reactor.** Hanson, J.D. College Park, MD; Univ. of Maryland (1982). 60p. University Microfilms Order No. 83-18,898.

Thesis (Ph. D.).

Because their energies greatly exceed the plug potential, fusion reaction alpha particles in a tandem mirror reactor will be mirror confined rather than electrostatically confined by the end plugs. Hence, the alpha particle distribution function will have a loss cone. This anisotrophy in the distribution function is shown to destabilize Alfven waves in the central section of a tandem mirror reactor. The wave equation with a modified cold plasma response is used to determine the radial mode structure and real frequency of the Alfven waves in cylindrical geometry. The growth rate is calculated from the resonant particle part of the plasma response. Destabilization of the wave occurs due to a cyclotron resonance of the alpha particles. The resonant interaction of the wave with the alpha particles will pitch-angle scatter the alphas into the loss cone, effectively widening the loss cone. In a typical fusion plasma (central ion temperature T/sub io/ = 20 keV, central electron temperature T/sub eo/ = 20 keV, central beta β/sub c/ = 0.4, vacuum magnetic field B/sub v/ = 3T) we find 60% of the alpha particle energy is lost when the effects of the instability are included, whereas only 17% is lost without the instability.

25166 **Radial space potential measurements in the central cell of TMX with a heavy ion beam probe.** Hallock, G.A. Troy, NY; Rensselaer Polytechnic Inst. (1982). 276p. University Microfilms Order No. 83-03,068.

Thesis (Ph. D.).

Spatial and temporal profiles of the space potential in the central cell midplane of TMX have been obtained with a heavy ion beam probe. The absolute accuracy of measurments is +-25 Volts (with respect to the machine vacuum walls) with a resolution of ~ 2 Volts. During moderate fueling with the gas boxes (i/sub gas/ ≅ 1200 Atom-Amperes D_2), the plasma potential is parabolic to at least 25 cm radius, with phi/sub e/ ≅ phi/sub max/[1-(r/32)^2] and 300 < phi/sub max/ < 450 Volts. With puffer valve fueling the space potential is relatively flat to at least 27 cm radius, with 250 < phi/sub e/ < 350 Volts.

25167 **Measurements of electron density and plasma current distributions in tokamak plasma.** Ma, C.H.; Hutchinson, D.P.; Staats, P.A.; Vander Sluis, K.L. (Oak Ridge National Lab., TN). *International Journal of Infrared and Millimeter Waves;* **3**: No. 2, 263-277(1982).

A submillimeter-wave, phase-modulated polarimeter/interferometer is used for simultaneous time-dependent measurement of line-averaged electron density and poloidal field-induced Faraday rotation along chords of the plasma column in ISX-B tokamak. Heterodyne detection and hollow dielectric waveguide are utilized to achieve the high sensitivity required for the multichord experiment. A data analysis code has been developed to reconstruct the asymmetric distributions of plasma density. The validity of the code is examined, and the result shows good agreement with density profiles measured by Thomson scattering.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 25032, 25153, 25164

25168 **Engineering of magnetic fusion reactors.** Conn, R.W. (Univ. of California, Los Angeles). *Scientific American;* **249**: No. 4, 61-71(Oct 1983).

Design projects under way and experimental reactors now being built will test the practicality of schemes for generating power from the thermonuclear fusion of ions trapped by magnetic fields. A review of present-day devices such as MFTF-B, JT-60, TFTR, T-15, TORE-SUPRA, and JET is given.

25169 **Recovery of electron sheath current in magnetically self-insulated transmission lines.** Crow, J.T.; Peterson, G.D. (Sandia National Laboratories, Albuquerque, NM 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **11**: No. 3, 219-222(Sep 1983). Contract AC04-76DP00789.

Magnetically self-insulated lines operating at high electric field stress have a high percentage of the current flow in an electron sheath adjacent to the cathode. Recovery of the current in this sheath is desirable for efficient power transport. The Sandia National Laboratories HydraMITE accelerator has a magnetically insulated transmission line (MITL) which has a 7.6-Ω geometric impedance and operates at 4.8 Ω, indicating that approximately 40 percent of the current flows in the electron sheath. If this line is terminated in a section of higher impedance line, theory and simulations indicate that the electron sheath current will be lower at the output. This higher impedance section, however, is effectively an inductance across which there is a voltage drop during the rising part of the pulse. An experiment was conducted on the HydraMITE machine in which input and output currents were measured on a section of line which the impedance changed smoothly from 7.6 Ω to 20 Ω. At the output the electron current was a few percent of the total current. Measurements were made with a range of inductive and resistive loads. The input and output currents were then compared to lumped circuit line simulations to separate losses related to inductance from electron sheath losses. The measurements indicate that a percentage of the electron sheath is recovered which depends on the load impedance and that the recovery is more efficient after the pulse voltage peak where potential drop along the increased impedance line aids retrapping of electrons.

25170 **X-ray spectroscopy measurements of laser compressed, argon filled shells.** Yaakobi, B.; Villeneuve, D.M.; Richardson, M.C.; Soures, J.M.; Hutchison, R.; Letzring, S. (Univ. of Rochester, NY). *Optics Communications;* **43**: No. 5, 343-346(1 Nov 1982).

Argon x-ray lines have been used in the past to diagnose laser-compressed targets. We extend such measurements to: (a) very high densities (rho ~ 9 gcm^{-3}) obtained when imploding small shells with short laser pulses, and (b) lower densities but higher rho R values (~ 4 mg cm^{-2}) obtained with large DT-Ar filled shells, imploded with long laser pulses. The 24-beam OMEGA laser has been used with 4 to 5 TW, 100 ps pulses in (a), and 1.5 to 2 TW, 1 ns pulses in (b).

25171 **$CS^+ + Cs^+$ charge transfer and ionization cross section measurements by a plasma target technique.** Stalder, K.R. Berkeley, CA; Univ. of California (1982). 176p. University Microfilms Order No. 83-00,668.

Thesis (Ph. D.).

Ion-ion collisions relevant to the heavy-ion fusion program have been studied by a plasma target technique. These collisions may limit the allowable storage times for high energy beams in storage rings. If ion-ion collisions lead to charge-changed product ions then the lost ions will lead to lost beam intensity and perhaps damage to beamlines. The interaction of desorbed wall material with the beam might catastrophically disrupt the beam.

25172 **Measurement of fuel rho R in laser fusion targets using elastically scattered fuel ions.** Kacenjar, S.T. Rochester, NY; Univ. of Rochester (1982). 216p. University Microfilms Order No. 83-02,136.

Thesis (Ph. D.).

The first direct measurement of the fuel rho R in laser fusion targets has been achieved by counting the number of elastically scattered fuel ions, knock-on particles off 14.1 MeV DT-neutrons. Also measured for the first time was the knock-on energy spectrum which agreed well with predicted results. Both measurements required the use of thin CR-39 solid state track detectors. The presence of a proton background necessitated the development of three track criteria based on particle range and velocity to separate the knock-on deuterons and tritons from energetic protons with energies greater than 3 MeV. Also examined here is the immediate utilization of knock-on forward-scattered deuterons to probe non-uniform fuel compressions. This requires the use of at least two track

detector packages to view the target from different orientations. A detailed discussion is also given on the future extension of the fuel rho R measurement when target rho R conditions exceed 4 mg/cm^2.

99 GENERAL AND MISCELLANEOUS

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 24938, 25029

25173 (DOE/ER/13069—T1) Topics in large sparse nonlinear optimization. Progress report. Coleman, T.F. (Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science). Apr 1984. Contract AC02-83ER13069. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008933.

Progress is reported in the development of practical and efficient algorithms and software for the solution of large sparse numerical optimization problems. Several of the originally proposed ideas will continue to be pursued. (GHT)

25174 (LA-UR—84-139) MSS generic model: a beginning. Collins, W.; Miller, S. (Los Alamos National Lab., NM (USA); SRI International, Menlo Park, CA (USA)). 1984. Contract W-7405-ENG-36. 8p. (CONF-840665—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006015.

From 6. IEEE symposium on mass storage systems; Vail, CO, USA (4 Jun 1984).

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To improve communications and understanding in the field of Mass Storage Systems (MSS), the need exists to formalize the definitions and concepts of MSS. This presentation gives MSS definitions followed by the development of a generic model for MSS.

25175 (LA-UR—84-988) AIRID: an application of the KAS/Prospector expert system builder to airplane identification. Aldridge, J.P. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 8p. (CONF-8404128—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009975.

From SPIE conference; Bellingham, WA, USA (29 Apr 1984).

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The Knowledge Acquisition System/Prospector expert system building tool developed by SRI, International, has been used to construct an expert system to identify aircraft on the basis of observables such as wing shape, engine number/location, fuselage shape, and tail assembly shape. Additional detailed features are allowed to influence the identification as other favorable features. Constraints on the observations imposed by bad weather and distant observations have been included as contexts to the models. Models for Soviet and US fighter aircraft have been included. Inclusion of other types of aircraft such as bombers, transports, and reconnaissance craft is straightforward. Two models permit exploration of the interaction of semantic and taxonomic networks with the models. A full set of text data for fluid communication with the user has been included. The use of demons as triggered output responses to enhance utility to the user has been explored. This paper presents discussion of the ease of building the expert system using this powerful tool and problems encountered in the construction process.

25176 (SAND—84-0302) GRAPH II: a digitizing and graph plotting program. Selleck, C.B. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010747.

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GRAPH is an interactive program that allows the user to achieve two objectives. The first is digitizing graphs or plots to create data files of points. The second is the inverse of the first: plotting graphs from data files onto a graphics device. The program has extensive internal help and is designed to allow the user to get results quickly and easily. It is written in RATFOR and is intended for use on a VAX computer. The program provides graphical output through all of the Sandia Virtual Device Interface (VDI) graphics devices.

25177 (UCID—19889-Rev.1) Communicating between the IBM Personal Computer and the Wang word processing system. Downey, R.M. (Lawrence Livermore National Lab., CA (USA)). 15 Mar 1984. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010423.

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This manual outlines the steps for transferring documents to a Wang OIS word processor from an IBM Personal Computer (PC) and for retrieving stored documents from the Wang. We first look at hardware and software needed to connect the two systems before detailing the steps you should take in transferring a document.

25178 (UCID—20045) TOPAZ - a finite element heat conduction code for analyzing 2-D solids. Shapiro, A.B. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010676.

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TOPAZ is a two-dimensional implicit finite element computer code for heat conduction analysis. This report provides a user's manual for TOPAZ and a description of the numerical algorithms used. Sample problems with analytical solutions are presented. TOPAZ has been implemented on the CRAY and VAX computers.

9903 Information Handling

25179 (ORNL—6002) Information Center Complex publications and presentations, 1971-1982. Hawthorne, S.W.; Johnson, A.B. (Oak Ridge National Lab., TN (USA)). Feb 1984. Contract AC05-84OR21400. 227p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84010603.

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This indexed bibliography lists publications and presentations of the staff of the Information Center Complex, Information Division, Oak Ridge National Laboratory, from 1971 through 1982. Entries cover such topics as toxicology, air and water pollution, management and transportation of hazardous wastes, energy resources and conservation, and information science. Publications range in length from 1 page to nearly 4000 pages and include topical reports, books, journal articles, fact sheets, and newsletters. Author, title, and group indexes are provided. Annual supplements are planned.

25180 (DOE/TIC—4579(Rev.13)Pts.1and2) Energy data base. Serial titles with ISSN listing. Hendricks, P.L. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). Mar 1984. 1213p. NTIS, PC A99/MF A01. Order Number DE84003876.

This issue of Serial Titles with ISSN Listing is the first revision of DOE/TIC-4579 to include the International Standard Serial Number (ISSN) for journals. The TIC journal authority was established to bring about conformity in citing the approximately 16,000 titles contained in this authority. It can prove to be a valuable tool in establishing the precise journal by ISSN and CODEN indication, especially for journals with the same title published in different locations. Serial Titles with ISSN Listing is comprised of two parts. Part 1 is an alphabetical listing by full title of the publication and also includes abbreviated title, CODEN, ISSN, coverage code, and country code. Part 2 is an ISSN-title correlation arranged in numeric order by ISSN and also includes the CODEN and full title.

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Andra Partners, Cedar Rapids, IA (USA)
Environmental Quadraplex. Final report, 9:24688 (R;US)
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Qualifier
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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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DOE/CS/50028-1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010630	STD -96	9:24899
DOE/EA-0082-Rev.	NTIS MF A01; 2 (GPO Dep.)	DE84010473	MN -70A	9:24636
DOE/ER-130	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009740	MN -98E	9:24802
DOE/ER/00038-2552	NTIS, PC A03; 3 (GPO Dep.)	DE84008505	MN -4	9:24648
DOE/ER/02009-148	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010593	MN -34D	9:25130
DOE/ER/10250-T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008843	MN -98D	9:24805
DOE/ER/10978-8	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008224	MN -34	9:25119
DOE/ER/13026-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010480	MN -63	9:24665
DOE/ER/13069-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008933	MN -32	9:25173
DOE/ER/13107-1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008593	MN -48	9:25082
DOE/ER/13163-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008589	MN -38	9:25024
DOE/ER/60014-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010509	MN -48	9:25091
DOE/ER/70107-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008841	MN -34D	9:25128
DOE/ER/72012-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008935	MN -32	9:25124
DOE/ET/13800-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84008562	STD -90j	9:24581
DOE/ET/14363-T14	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010819	MN -91	9:24613
T15	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010818	MN -91	9:24614
T16	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010821	MN -91	9:24615
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DOE/ET/20074-T19	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008200	MN -61B	9:24666
DOE/ET/27111-T3	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010481	MN -66a	9:24707
DOE/ET/29372-3	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84008519	STD -97b	9:24717
DOE/EV/04427-62-App.E	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84010955	MN -90b	9:24591
DOE/EV/10455-T1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84008958	MN -11	9:25062
DOE/EV/10661-T1	National Wildlife Federation, 1412 16th Street, NW, Washington, DC 20036		ND -11	9:24797
DOE/FC/10225-1584	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010496	STD -90i	9:24586
DOE/FE/60173-2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008847	MN -13	9:24898
DOE/FE/60181-17	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84008488	STD -90	9:24582
68	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009230	MN -90a	9:24583
DOE/ID/12044-T3	NTIS, PC A08/MF A01 (GPO Dep.)	DE84007672	MN -66	9:24708
DOE/ID/12512-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010808	MN -70B	9:24629
DOE/JPL-1060-65	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84008508	STD -62	9:24678
DOE/MC/14400-1551	NTIS, PC A15/MF A01 (GPO Dep.)	DE84006316	STD -90c	9:24570
DOE/MC/19299-9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010825	MN -90b	9:24571
DOE/MC/20212-1569	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010485	STD -93	9:24809
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DOE/OR/03054-10	NTIS, PC A17; 3 (GPO Dep.)	DE84010810	STD -89	9:24587
60	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010811	STD -89	9:24572
DOE/PC/50001-22	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010608	STD -90d	9:24573
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2-Vol.2	NTIS, PC A15; 3 (GPO Dep.)	DE84010694	STD -92	9:24607
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DOE/R7/01003-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007812	MN -59a	9:24697

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T1	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007715	MN -59c	9:24698
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T1	NTIS, PC A02 ; 3 (GPO Dep.)	DE84007844	MN -59	9:24691
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T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010099	MN -95d	9:24850
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T2	NTIS, PC A02; 3 (GPO Dep.)	DE84009769	MN -59a	9:24692
T3	NTIS, PC A02; 3 (GPO Dep.)	DE84009770	MN -59a	9:24693
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010453	MN -95e	9:24896
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010454	MN -95d	9:24851
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T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010458	MN -61	9:24662
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T1	NTIS, PC A03; 3 (GPO Dep.)	DE84010433	MN -95	9:24852
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T1-Vol.2	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84005555	MN -90c	9:24599
T4	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84005561	MN -90c	9:24600
T5-Pt.1-Exec.Summ.	NTIS, PC A03/MF A01 (GPO Dep.)	DE84005566	MN -90c	9:24578
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T11	NTIS, PC A03/MF A01 (GPO Dep.)	DE84005564	MN -90c	9:24577
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T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010649	MN -92a	9:24602
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T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84009514	MN -58d	9:24663
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1642	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84010620	STD -11	9:25074
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25483	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007686	MN -61B	9:24667
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17367	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010567	STD -94c	9:24971
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17491	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84010708	MN -70	9:25112
17570	NTIS, PC A05; 3 (GPO Dep.)	DE84010711	MN -32	9:25146
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2691	NTIS, PC A05/MF A01; - GPO* (GPO Dep.)	DE84010350	MN -78	9:24748
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3507	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84006685	MN -80	9:24742
3631	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84010223	MN -80	9:24745
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UG Uganda
US United States of America (USA)
UY Uruguay

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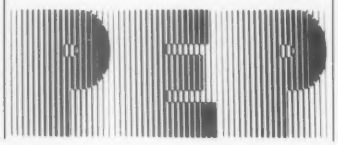
PERSONAL ENERGY PROFILE (PEP)

COMPUTER SEARCH SERVICE



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